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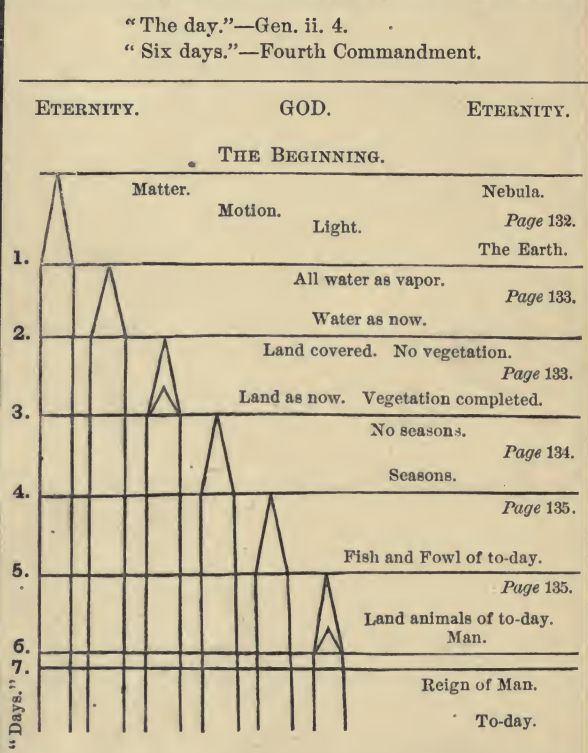
"The day."—Gen. ii. 4.
"Six days."—Fourth Commandment.



The apex of each angle denotes the beginning of a stage of progress, increasing to completion, after which there was no further development in that direction. This is indicated by the parallelism of the lines. See pp. 131–135, also p. 92, p. 157, p. 165. The horizontal numbered lines denote the position of the "days," each marking the close of an epoch of immeasurable length. The work done, or progress made between the "days," is described for each epoch, on the page referred to.

The double angles indicate a double development.

"*STRIKE, BUT HEAR ME.*"

THE MOSAIC ACCOUNT OF CREATION,

THE MIRACLE OF TO-DAY;

OR,

NEW WITNESSES TO THE

ONENESS OF GENESIS AND SCIENCE.

TO WHICH ARE ADDED

AN INQUIRY AS TO THE CAUSE AND EPOCH OF THE PRESENT INCLINATION OF THE EARTH'S AXIS, AND AN ESSAY UPON COSMOLOGY.

"The most important thing for us in every branch of knowledge, is to see the thing as in itself it really is."—ARNOLD.

BY

CHARLES B. WARRING.

UNIVERSITY OF CALIFORNIA

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1875.

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PREFACE.

My purpose in this Essay is to compare the statements in the first two Chapters of Genesis with the scientific discoveries and conclusions thus far attained. I have endeavored to do this as fairly and *thoroughly* as possible, and while I am well aware that my conviction of the superhuman character of that Account permeates this book, yet I confidently appeal to the words of Moses on the one hand, and to Scientists upon the other, as to the correctness of my statements. It is a true saying that a belief is not necessarily true because it is old, nor false because it is new. Each one should stand, or fall, according to the character of the evidence adduced in its behalf—a principle for which the Reader will find use.

There is little Science in this Essay that is not the common property of all who have in any degree kept up with the progress of Physical research. Indeed, by far the larger part is strongly insisted upon, or quietly assumed as needing no further proof, by Evolutionists, with whom, however much it may be my lot to differ on other

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subjects, in these I agree most fully. I have, however, taken scientifically heterodox ground in reference to a change of the earth's axial position. For a full discussion of this, and also a development of the Nebular Hypothesis, the Reader is referred to Part III. Should it be shown that my argument is erroneous, and that I am wrong in my views in reference to the work of the "fourth day," the Reader is reminded that it is the explanation only, and not the Narrative itself, that he has proved false. This still remains, and, if true, will surely at some time so appear.

The Geologic Record from the close of the Tertiary, or the beginning of the Glacial Epoch, lacks the fulness and exactness that mark the older periods. One most important fact, however, has been established beyond question, viz. that the present "*living*" species of fishes, birds, reptiles, and mammals, as well as Man, appeared after that date, and I think I may add, after the *dominance* of the Glaciers.

In a few instances I have ventured to change the received translation to one that seemed nearer to the very words of Moses. Above all things in this discussion, there is needed perfect thoroughness that shall leave no after questions to come up. Any decision based upon a version that attempts to improve upon the Hebrew, or which ignores any physical fact or law, germane to the

subject, must be just so far defective, and cannot bear the test of examination.

Friends and foes have united in rejecting the claim of the Mosaic Narrative to be *literally* true.* The former, or at least many of them, style it a Hymn of Creation or an Allegory, and escape all scientific difficulties by the assertion that Moses taught, not Physics, but Morals. The rejectors of this narrative style it a Myth or Fable, and dogmatically, and even superciliously, assume its unhistorical character to have been so well established "that the student of science . . . will not trouble himself further with these theologies, but will confine his attention to such arguments against the view he holds as are based upon purely scientific data." †

I hope it will not be deemed presumptuous to hold an opinion directly the opposite, for it is in no spirit of vanity that I differ from so many wise and able men, at whose feet, as a learner, I would gladly sit. In this independence of thought I am encouraged by the words of cheer uttered just now at Belfast by one whose eloquence is surpassed only by his science. Whoever else may give harsh and suspicious greeting to this effort to

* Even such a stanch advocate of its divine origin as Prof. Dana, Manual, p. 767–8, says, "the account must bear marks of human imperfection." "In the style of a sublime intellect. . . . unversed in the depths of science which the future was to reveal."

† Prof. Huxley.

discover the true correlation of Genesis and Science, I feel assured of a patient hearing from such men in the search after truth, and that no prejudice nor pride of opinion will prevent their holding an equal balance in which the reasons offered may be impartially weighed.

It was my purpose to indicate some of the more important points in this discussion, but I find it difficult to make a selection. Perhaps the chronological order is worthy of special note; as is also the work of the "third day." The sharply defined character of the latter, and the equally clear Geological record in reference to the same developments, render the comparison eminently satisfactory. Attention is also called to the "readings between the lines." These, perhaps as much as anything else, throw light upon the truthfulness of the Narrative.

It will be seen that I have added another to the attempts to solve the meaning of the "days." The solution I offer has the drawback of novelty, and, perhaps, nothing in this Essay will so cross and disturb a belief hoary with antiquity. It seems to me, however, impossible to reject it, so exactly and easily does it meet *all* the conditions of the problem, the wording of the "day clauses," and of the fourth Commandment, as well as *all* the Astronomical and Geological facts. As to this and other theories advanced in this Essay, responsibility attaches to myself alone, save so far

as germs of thought from other sources have been insensibly wafted into my mind. In no case, as far as known, has any other writer entered upon this subject, taking the very words, *verba ipsissima*, of Moses as the basis of comparison.

The Introductory article is specially devoted to Believers in a Revelation. It was thus more easy to say certain things deemed important, but which seemed out of place in the more purely Scientific part. Yet there are matters in it of interest to others and of use in understanding the rest of this book. The first, second, and fourth chapters were originally letters to ——. This may help explain some peculiarities of style and arrangement.

I add a few words in reference to certain allied matters not strictly within the scope of this book, but which, some may think, ought to be spoken of in such an Essay as this.

A class of Scientists of distinguished ability have reached a conclusion to their inquiries into the origin of things, in the proposition that "all evolution" is due to a Power Unknowable, a proposition which they appear to regard as an important outstretch of the human mind. I can understand that one can positively and truly assert that this Power is unknown to *him*, or that, on the authority of a person who has thoroughly examined and comprehended this Power and the capacity of the human mind, he may receive as a

matter of faith the assertion that this First Cause is "Unknowable," but how any man can assert this of his own authority, I cannot conceive. The very affirmation implies the most exhaustive knowledge, and thus destroys itself. This, however, is a FALSE ISSUE, of not the slightest practical value. The only question that concerns us is, Can this Power make himself known to us? Does he interest himself in his creatures? Does he regard their welfare? If so, can he let us know it? I can communicate my wishes to my fellows; even the brutes have, in a limited degree, the same faculty. Has this Unknown Power less ability? These are questions that have not yet received, from those whose motto is, "Freedom of inquiry in all directions," that attention which their importance demands.

A possible proof of a Revelation has of late made much stir in the world, and it may be thought that I have not given it due consideration. I refer to the so-called PRAYER TEST. It is, however, fairly included in what is said in the first chapter about miracles. I may add, however, that it is nothing new, for the Old Testament abounds in Prayer Tests. Many of these will occur to the Bible student. I shall mention only one, selecting that, partly on account of its appositeness, and partly as illustrating the use of the words Jehovah and God. I refer to Elijah's prayer for a direct physical answer to the then

practical question, whether Jehovah be God, or whether Baal be God.*

A comparison between Genesis and Science which omits all notice of Evolution by Natural Selection, will, to many minds, seem to lack an important element of completeness. To such it may be said, that Evolution *without higher guidance* is proved false, if the Account in Genesis is true. Hence, if this be established, such Evolution needs no other refutation. But Evolution under the control and direction of the Great First Cause, God, is not incompatible with the truth of that narrative. It may even be true to a large extent, but, that it is infinitely more under his control than the development of certain breeds of cattle, or varieties of pigeons, is under the control of intelligent men, the truth of the Mosaic Account of Creation, if established, conclusively proves.

* See 1 Kings xviii. v. 21–39. Note in v. 39 the use of these words implied in the utterance of the convinced and convicted people, "Jehovah, he is the God, Jehovah, he is the God."

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INTRODUCTORY.

TO THOSE WHO RECEIVE THE BIBLE AS A REVELATION FROM GOD.

THE great religious question of to-day resolves itself into three: Is there a God? Is he a personal God? Has he given us a revelation?

An affirmative answer to the last, if sustained, is an answer to all. In reference to the sufficiency of the reply, it is a matter of no consequence, whether that revelation be long or short, whether it is contained in one chapter or fifty. It is the fact that *any* revelation has been made, that conclusively answers the questions.

Still, if it could be shown beyond cavil, that one chapter of a book claiming to be a revelation, was really such, the probability of a like authority for the other portions would be infinitely increased, and the burden of proving a negative would be thrown upon those who deny it.

The reality of such a revelation is earnestly asserted on the one side, and denied upon the other. The controversy has been long, each party claims the victory thus far, and each professes to be confident of the final result.

But to one who studies the history of the last hundred years, it is evident that the real success has been with the defenders of a revelation, at least in the departments of History, Archæology, Philology, and Geography, although these were, not long ago, loudly proclaimed as *the* witnesses that, when fully heard, should destroy the credibility of the Bible; for, whatever men may say as to other revelations, the Bible is the only book that is seriously considered by those who have engaged in this conflict.

So overwhelmingly corroborative is the result of these investigations, that we shall probably hear no more against the historical verity of the Bible. The same class of opponents are now weaving theories on which the facts recorded may be strung as facts, but with a purely natural explanation.

The conflict at the present day is more intense than ever, perhaps because it is limited to the one field of Natural Science, perhaps from a consciousness that no other strong line of attack is left.

The assaults more or less directly centre on the Mosaic Account of Creation. In fact, that is the key to the whole position. Its assailants must show its falsity or admit the reality of a revelation. If they fail in that, all is lost. There is not left them even a safe line of retreat. To admit the truth of the Mosaic account, annihilates disbelief in the personality of God, in his personal interference in the affairs of men, and in miracles, for it

is itself, if true, a personal interference and a miracle, the very things as to whose existence there was debate.

Into this conflict I propose to enter, not to explain and soften down the words of Moses, but to take them, *verba ipsissima*, just as written, abating not one iota.

This narrative deals with events that occurred, if they occurred at all, before man appeared upon the earth. It cannot therefore, like many other parts of the Bible, be collated with ancient manuscripts or monumental inscriptions.

But we have other means of testing it, unknown till within the last few decades. These are found in the positive knowledge of very many important facts in our world's ante-human history.

I turn therefore to the marvelous results obtained by astronomers, geologists, and philosophers, and summon the sciences they have called into existence. By these I propose to show the *literal* truth of the first two chapters of Genesis, not only as to the things said to have been done, but, what is, if possible, more extraordinary, as to the very order of their occurrence.

No scientist can challenge these Witnesses. Indeed, his rejection of them would be suicide, while their admission is fatal to the whole array of infidelity based upon a supposed contradiction between Moses and the history of our world as recorded by Nature herself.

Nor can they be charged with a bias toward the supernatural. Indeed, by a strange but providential misapprehension, it has been, and is even now, the loudly proclaimed belief of the opponents of the Bible, that the evidence of these Witnesses, if fairly and impartially received, would result in the consignment of the Book to the myths of an effete mythology, by the side of Hindu and other absurd Cosmogonies.

While no believer in the Bible shared such expectations, having grounds for his belief independent of all theories, it must be admitted that many have felt great fears of Science, and have watched its progress with jealous eyes. Anticipating a conflict of statements, they have taken refuge in the assertion that the Bible is a No-Science Book; as if the God of all science could indite an account of creation, and give no information about it!

The evidence that will be presented in this essay will be drawn from the following Sciences:

Astronomy; including the Nebular Hypothesis, Cosmic changes from the Nebula to the Planet, the present condition of the Sun and larger planets, the Stellar Universe, and also the attraction of gravitation and the laws of motion.

Optics; embracing the Undulatory Theory of Light, and the results of Spectroscopic observations.

Geology; including Paleontology, and espe-

cially the Glacial Period, in reference to its Biological Epoch, as well as Climatic position.

Geography, Physical and Descriptive.

Botany, and Zoology, and Meteorology. The last at least as far as the laws regulating the capacity of the atmosphere for water.

In addition to these, evidence derived from the following generalizations reached only of late by modern thought:

The Correlation of Forces.

Uniformity of Law.

A Law of Development.

As to a portion of the testimony there will be more or less questioning; but as to the great mass, it will so clearly corroborate the story in Genesis, that its very completeness will render the reader incredulous at first, as when one has unexpectedly fallen upon some great vein of gold, he stands dazed and refuses to believe his own eyes.

I am aware also of the peculiar parentage of some of these Witnesses, and do not wonder that the simple-hearted believer, who has in his own consciousness a Witness that no Science can give or comprehend, should start back and exclaim, "Timeo Danaos et dona ferentes." *

My argument is not for such, but for that large class to whom Science is the only revelation. It would be outside of my plan to attempt to establish for others the truthfulness of my Wit-

* I fear the Greeks even bringing gifts.

nesses. Those who doubt it, will find excellent works specially on these subjects. If, however, for reasons satisfactory to themselves, they believe the Mosaic narrative to be true, I do not see how they can avoid accepting the results of Science, so far at least, as they are employed in this essay. In fact, the two corroborate each other.

Should any one who reads this book find in it statements as to what Moses says, or does not say, which run counter to his belief, I beg him to see for himself whether they are sustained by the words of the writer.

It has been apologetically said that this account is phenomenal, and that of course its statements were not intended to be taken literally.

They are indeed "phenomenal," and so is the coming transit of Venus, so are the photographs of that "phenomenon," which Scientists will soon be studying with micrometer and microscope. "Phenomenal"! indeed they are, and hence their realism, their photographic truth.

I trust no one will so misunderstand me as to suppose I intend this assertion of positive literalism to embrace the whole Bible. No book more abounds in poetical imagery, none would lead to greater absurdities, if received without that common sense which we apply to all others.

It was the lack of this, and the substitution of the Commentators' notions derived from figura-

tive portions of the Bible, and largely from false Science, for the simple words of Moses, that produced the strange vagaries which have been charged to, and attacked or defended, as parts of the Biblical account of Creation. Where in the first two chapters of Genesis (or elsewhere) did Cosmas find authority for believing the world was modelled after the tabernacle? Where learn that the earth is just twice as long as it is wide? or that there are no antipodes? Yet defending these, and other equally groundless absurdities, is even now claimed to be the necessary result of receiving these chapters as literally true! *

The truth is, this account of creation, like the fifty-third of Isaiah, is utterly incomprehensible until the true explanation is found. The account of our Saviour's sufferings and triumphs seemed a strange and touching medley, that could never be aught else than poetical metaphors; but when the prophecies became history, it was seen to be the simple, touching story of the Man of Sorrows, so literal that it reads like the words of an eye-witness. Its strange and apparently contradictory statements meant just exactly what they said.

Why add to the text *our* suppositions? Why

* In spite of all that has been said about the folly of believing the literal truth of the Mosaic account, no writer or speaker, as far as I know, has ever taken it to be literally true. Paradoxical as this seems, I believe an examination of writings upon Genesis will sustain this assertion.

take anything from it? We have no right to do so. Moreover, we thus only raise structures for its opponents to batter down. From one such to another, the defenders of this account have been driven, until it is no wonder that Scientists, forgetful of their own greater vagaries, sneer at the abortive efforts to make—not the words of Moses—but Commentators' explanations square with their (the Scientists') theories.

It will be found, I think, that the only tenable ground is based upon the assumption that in this narrative we have the carefully worded and arranged account of an Eye-Witness who could say of the things he relates, as did the Son of Anchises, but in an infinitely higher sense, "Quorum fui magna pars." *

At the commencement of the study of this Narrative I assumed, as a proposition self-evident in itself, that there could be no modern discovery of any ante-human fact, whether an event, or a law, or an order of occurrence, that was not infinitely better known to God at the time he is said to have given this account to Moses, than it can be, to-day, to the wisest Scientist.

Hence, if there should be any error found in it, either the Narrative is from a being of limited intelligence or the reader has misunderstood it. Clearly, then, the questions to which I ought first to apply myself were these: What does the Ac-

* Of which I was a great part.

count say? and what meaning is intended to be conveyed?

In general there is but little difficulty in answering the first question.* Our common Version is in the main sufficiently exact, although I would in some things go closer to the original, as in the use of "expanse" for firmament, and in the translation of certain clauses in reference to the "days," as will be fully set forth hereafter.

As to the second inquiry, "What meaning is intended to be conveyed?" I found most abundant room for study. I turned first to those writers who had made Genesis a special study, but did not find that harmony between their assertions and the facts of our world's history which the high claims of the Narrative appeared to demand.

There remained the story itself. To it I turned, seeking in every direction for a solution of its difficulties, groping in the dark, feeling my way passage by passage, testing now this theory and now that, only to throw away one after another, as I came to insurmountable obstacles or flat contradictions between the proposed solution and what I knew to be facts. At last, after many days, flashed upon me, in all the sublimity of its divine simplicity, the key to the mystery.

* There is a rich mine of precious metal yet to be worked by some Hebrew scholar who shall thoroughly search the original with all the light of physical science.

THE NARRATIVE MEANS EXACTLY WHAT IT SAYS; NO MORE, NO LESS; AND THE ORDER THERE GIVEN IS THE EXACT ORDER IN WHICH OCCURRED THE EVENTS IT RECORDS.

This I did not start with as an *a priori* principle: it came to me after an exhaustive examination of everything else. Now, I can see that it is only a corollary of the proposition I started with, and it is wonderful to note how the two Records, seen through this, like the two pictures of a stereoscope, visibly glide into one and stand out from the page in their true perspective. Every line, although, in one when seen by itself, apparently useless, yet viewed with its other part, helps the marvelous truthfulness of the resultant view.

PLAN OF THIS BOOK.

In the first chapter, after showing the intrinsic possibility and desirableness of a Revelation, I consider the different methods of establishing its authenticity. I then take up the Mosaic Account as claiming to be a revelation, and endeavor, by removing the accretions of the ages, to narrow the discussion to the text. I inquire as to the purposes of the Author in making this particular Revelation, and examine the objections which have been made to the credibility of it, on scientific grounds.

In the next chapter, after seeking to cultivate in the reader a sense of historical perspective, I

collate the statements of Moses with those of the "Witnesses."

This is followed by a disquisition upon the "days."

In the fourth chapter is considered the Law of Development and its relation to this Narrative; which is followed by a further comparison of Science and "Revelation."

The Account found in the second chapter of Genesis is examined in the fifth of this.

In Part III. is a full discussion of the work of the fourth day, inquiring as to the time and cause of the present inclination of the earth's axis. This inquiry is conducted solely as a physical question, in the light of astronomy and the geological developments of organic life considered with strict reference to Uniformity of Law. The Inquiry reaches beyond our earth, and in "Cosmology," the Nebular Hypothesis is shown to account for a great variety of facts in the Solar System.

Whatever doubt there may be as to the correctness of my exposition of the work of the fourth day, and whether my positions in reference to it can be maintained or not, the reader will note that it is an independent portion of the argument for the truth of Genesis, and may be rejected without affecting the remainder.

I have often regretted while studying this Narrative, that some one who was master of the subject and gifted with fitting command of language, had

not given, in plain Anglo-Saxon, and with a brevity approaching that of Moses,* an authoritative statement from a purely scientific stand-point, of the world's ante-human history, taking up the same topics.

Will not Tyndall, or Spencer, or Huxley yet do it? It is difficult to conceive of a work of greater interest.

In a second Part are discussed various matters more or less intimately connected with the account in Genesis. In this the *literal* truth of that history is assumed as proved, and reference is made to it as in Geometry one refers to a previous proposition.

Probably, this intensity of belief will, at first, be shared by few, but the very clearness of my convictions, compels me to regard the acceptance of the same by others as only a question of time.

As to difficulties outside of these two chapters, it does not fall within my plan to discuss them. It may be, that in the present state of knowledge, it is impossible to satisfactorily remove them; but the lesson of the past should teach us to wait in patience, believing that He who could give the ante-human history of the world, can in due time vindicate his truth.

I will add, as the result of some careful study, that this Narrative grows broader and deeper the

* The Mosaic account, omitting repetitions and words of approval, contains only some three hundred and fifty words.

more it is explored and the more the full light of Science is turned upon it. Instead of a purling brook sweetly singing a "hymn of Creation" as it rolls over its pebbly bed, it expands to an ocean unfathomable and shoreless. It is not a history of our world merely, but an epitome of the Universe.

I trust the time is not distant when the true importance of this Account, as the highest possible *objective* evidence of the reality of a Revelation, will be recognized, and a professorship of Biblical Cosmogony be an acknowledged necessity in every theological seminary.

The light which shone in the face of Moses as he came down from the Mount, has always shone in this Narrative, but our eyes have been holden till now. Science, at last, has stripped off the bandages of ignorance and misapprehension, and revealed, not the vacuity too often fondly hoped for, but the insupportable glory of God the Creator, the Jehovah-Elohim.

In the conflict between truth and error now raging around us, if those who ought to lead in the battle, are to come down from their retreats in the "no-science" of the Bible, and, with a full and muscular belief which takes God's Book to be from the Fountain of all knowledge, assume the offensive, they must be shown that the first chapter of Genesis is the vital centre, the *locus vitæ*, of all Science. They must be made to comprehend that God's two Records are indissolubly one. Both

are true or both are false. When this belief shall have penetrated the marrow of their being, "their trumpet will give no uncertain sound."

I am weary of hearing those who claim to believe the Bible is from God, explain (?) away passage after passage, till the strongest words melt into a dim cloudiness, and there seems to be nothing so certain, nothing so fixed that it may not be shifted to meet our logical exigencies.

So thoroughly ingrained has this habit become that I fear the hardest thing to believe in this Essay will be, that the Author of Genesis intended to say exactly what he has said, and to be responsible for just that and nothing more, and that the most objectionable thing will be the rigidness with which this principle is adhered to.

To some good men the adherence to the *very words* of the text will, in their opinion, be the rejection, not of their beliefs, but of the account itself!

Will not the reader hold himself so far open to conviction as to test this method of exegesis, and judge of its correctness by the results?

PART I.

ADDRESSED TO SCIENTISTS WHO BELIEVE

THE MOSAIC ACCOUNT OF CREATION A MYTH.

"Let all the nations be gathered together, and let the people be assembled; who among them can show us former things? let them bring forth their witnesses that they may be justified; or let them hear and say it is the truth."—ISAIAH, XLIII., IX.

MOSAIC ACCOUNT OF CREATION.

CHAPTER I.

OBJECTIONS TO A REVELATION CONSIDERED.

NO one possessed of ordinary intelligence can, without deep interest, read of the labors of Scientists in enlarging the bounds of knowledge, or fail to admire the ingenious experiments and patient perseverance, the clear vision and close logic, by which they have achieved so many triumphs.

In my humble way, I sympathize with that spirit which dares to question Nature, deems her answers eternal verities, and fears no collision of truth with truth.

Some of these men whose achievements exalt our ideas of the capabilities of our race, and whose honesty no one has a right to question, assure us that they find in their search after truth, evidence of no other God than an unknown and unknowable First Cause, and that they know of no other Revelation than the phenomena of nature and the laws and relations existing between them.

In the presence of such, it is becoming to speak of one's self with modesty; yet, as to each his consciousness is higher than the authority of the greatest, I may say, that beyond nature I see, not merely *a* First Cause, but, judging as I must from the visible effects of his causation, an infinitely good, wise, and powerful Being. That he is infinitely powerful is implied necessarily in the assertion that he is the "First Cause." That he is good, I believe from the general character of creation; that he is wise, I am sure, since all Scientists are most earnestly engaged in the study of his works, and would scout as the most preposterous absurdity the assumption that any man or set of men ever had, or ever could, fully grasp their wisdom. So logically impossible is the negative of this, that no man, I apprehend, ever lived who could satisfy himself with it.

A large class, however, do deny that this Being has so far cared for man as to give him a written Revelation. This denial is based partly upon what seems to them its intrinsic improbability, and partly, though far more positively, upon its alleged conflict of statement with what they know to be truths derived from the study of his works.

The intrinsic improbability of a Revelation might well be asserted, if it could be shown to be needless. But I find in myself and in others a moral sense, imperfect, liable to be swayed by

prejudice or by honest errors of judgment, as well as by a natural inclination to decide that to be right which accords with my wishes. I notice, too, that it is only after many ages of experience, and a wide field of observation, that a few minds of unusual acuteness are able to deduce from "Sociology" any tolerable rules of life, while they utterly fail to obtain any light on our relations to the Supreme Being, or on the questions that force themselves upon every thoughtful person as to man's condition beyond the grave. "If a man die shall he live again?" is a question to which "Sociology" can give no answer.

A Revelation then is not needless. What *a priori* reason there is against it I am unable to discover. Certainly the great First Cause does not lack ability to give it. If he be "unconditioned," he is not bounded on any side by a "cannot," and the evident utility of such a manifestation of himself would mark it as eminently in harmony with the generous care that has provided so liberally for the physical well-being of his creatures.

The question then becomes one simply of evidence. Is there such a Revelation?

There is widely spread through the world a book which claims to have been given by God, and to speak with the weight of his authority.

In his name, it commands and forbids, promises and threatens. It professes also to give a limited, but so far as it goes, an accurate account

of man's state after death, and the conditions of future well-being.

It is at once admitted, that a book with such pretensions, needs to be well authenticated; and it will be well to consider on what evidence we should grant its claims, for we are reasonable beings, and are no more at liberty to submit ourselves to such demands without sufficient reason, than to close our ears to argument in their behalf.

Such a book might rest on miracles, or prophecy, or on a peculiar adaptation to the wants of the race. To many minds these would be abundantly sufficient, and such evidence is offered to all who choose to accept it. But there are those who deny miracles as not satisfactorily proved, or as in themselves impossible; who regard prophecy as poetry, or as written after the events it professes to foretell; and as for peculiar adaptation, that, being known only by personal experience, has no weight with those whose only gospel is the development that comes from unconsciously profiting by the experience of the race.*

I can imagine another kind of evidence which seems free from all these objections, and impossible to have been manufactured for the purpose, by any man or set of men, and yet abundantly within the ability of the author of Genesis, if as claimed, that author be God.

The Book might contain an account of events

* Herbert Spencer, Morals and Moral Sentiments, p. 17.

which occurred in the history of the world before man appeared upon it. Nothing would be so unanswerable as this, providing we were able to discover in some way what did actually take place. Such evidence would grow in strength as the race increased in knowledge. No metaphysical argument could weaken it, no question as to the reliability of testimony, no charge of deception, intentional or otherwise, could cast doubt upon it.

Such an account being, in the nature of the case, beyond the power of the writer, would be an EVER-PRESENT MIRACLE, which our own eyes could see, and which men of science, friends and foes, could carefully and leisurely examine. It would be more unanswerable than a continuation of miracles from Apostolic times to the present. For, raising the dead, healing the sick, or feeding the multitudes would from their very repetition cease to be miracles, and pass, like that greater act of omnipotence, the birth and growth of a human being, into the domain of law, and cease to be a wonder.

Modern science has given us the knowledge of many very important facts in the ante-human history of the globe, with which we can readily compare any statement that professes to come from a supernatural source.

It is evident from the nature of the case, that such a statement, if from the All-wise, must be capable of being fully comprehended only in pro-

portion to the knowledge and mental development of its recipients. But as that is far from being exhaustive, a proposition purporting to be from Him, should not be deemed false, because *we* fail to comprehend it, nor even if it should seem to us to be contradicted by known facts. One should be peculiarly cautious in coming to such a conclusion, when the matter in question is not the enunciation of a general law, or universal truth, but simply a statement of phenomena. There is nothing so unsafe to contradict, so intolerably obstinate, as an actual occurrence.

Newton was led to declare Huyghens' law of double refraction false, and the achromatic telescope an impossibility, because they appeared to him to violate well-established laws. The lesson to us from such mistakes, is to approach all questions of truth with reverent docility, ready to receive and firmly hold all *facts*, while our theories and preconceived notions should be bound to us by threads of gossamer.

This book, with its high pretensions, is before us. It is admitted on every side to have been in existence many centuries, and to have been handed down, as a precious heirloom, from the remote ancestors of a small nation on the eastern shores of the Mediterranean, never in the least distinguished for scientific attainments.

Is there in it such a statement of ante-human events as the argument justly demands? It

should be so profound as to be beyond the possibility of guesswork, and should cover so many points that chance coincidence becomes impossible. It may be incomprehensible, must have been so in the earlier ages of the world, may be so still in a greater or less degree, but it must contain no falsehood as that "the world rests upon the back of an elephant and that upon a tortoise."

Turning to the opening chapter of this Book, I there find what purports to be just such a statement as the argument demands. Beginning at "the beginning," it gives the early history of the world, not in mystic phrases or Delphian utterances, but in the simplest words, in the most unambiguous sentences. Here then is a crucial test. This account does or does not agree with the facts in the world's history brought to light by Science.

I accept the issue.

But before attempting to collate the account in Genesis with that found in the records of the rocks and sky, permit me to consider some preliminary matters and to clear the narrative from things foreign to it. I would throw aside, *save so far as they agree with the very words of Moses* (*verbis ipsissimis*), all statements of Commentators, Jewish or Christian, or of Scientists, ancient or modern, as to what he does or does not say. They spoke in good faith according to the light they had; as such in modesty I receive their

words, and give them thoughtful consideration, nothing more. No one ought to be influenced by mere authority.*

Since truth or falsehood is entirely independent of our acceptance, a statement as to who does or does not receive it, carries little weight to the earnest inquirer. Falsehood has had authority on its side more often than truth. Nearly all the great names in Science taught, within the memory of many of us, that heat was a fluid issuing from hot bodies, and light consisted of corpuscles shot out from the sun. The weight of astronomical authority, at one time, was in favor of cycles and epicycles and complicated machinery for explaining the movements of the heavenly bodies. The centuries are strewed with the debris of Scientific Theories.

But no one would think it just to reject the results of modern science, because of the errors and failures of the past, or to sneer at the efforts of Scientists to make their theories *square with one another, or with the facts of nature.* They would exclaim against such injustice, and demand that the truth or falsehood of what they deem a law of

* Prof. Tyndall, in his article on Science and Religion, says: "In our day, the best informed clergymen are prepared to admit that our views of the universe and its Author are not impaired but improved by the abandonment of the Mosaic Account of Creation."

I more than doubt the correctness of his broad assertion, but if true it is entirely irrelevant, save as an interesting historical fact.

nature be decided, not by what their predecessors may have said, but by its more or less perfect adaptation to, and harmony with, the facts concerned.

In like manner, when the question is as to the truth of the Mosaic Account, common justice demands that it shall not be condemned for theories or explanations that have proved false, nor because commentators have not agreed among themselves, but that it shall be judged by its own words, *verbis ipsissimis*. And as the Scientist justly requires us to accept as true his enunciation of a law if it harmonizes with the facts, we demand also the acceptance of the Mosaic Account if it harmonizes with the record written in the rocks and sky.

I am thus particular to confine the discussion to the text, because much passes current as the teaching of Moses, among the rejecters, and, to some extent yet, among the believers in his account, that does not belong to him.

During the ages there has gathered around his history a mass of theories, explanations and commentaries, outgrowths for the most part of the Science of those days, for which he is in no degree responsible. Their truth or falsehood does not affect the matter. They may be legitimate targets for the logic and ridicule of men better informed. It is the text, pure and simple, that claims to be a Revelation from God.

The Book of Nature as far as its pages have been *read*, not surmised or guessed at, I accept as truth and willingly rest the case upon it. This I do the more readily, SINCE NOW, FOR THE FIRST TIME IN THE HISTORY OF OUR RACE, HAS SCIENCE COME UP SO NEARLY ABREAST WITH THIS NARRATIVE AS TO PERMIT COMPARISON.

To the last few decades are due the demonstration (almost perfect) of the Nebular Hypothesis, the great law of the Correlation and Conservation of Forces, a tolerably complete knowledge of the nature of light, the invention of the Spectroscope, the collation and translation of the discoveries of Geologists, and eminently the knowledge of the Glacial Epoch. To this period is also due a great advance in Physical Geography, the discovery of a Law of Development, and of Uniformity of Law, and proof of the unity of physical constitution of the Stellar Universe and the Solar System.

I shall endeavor to show the harmony of these with the Mosaic Narrative, and more than this, that the Author of that wonderful Account knew of these discoveries, and that its rejection necessitates theirs.

By the Author of this Narrative I mean the person that furnished Moses with the facts which he, as the intelligent instrument, placed on record. As to how the story was made known to him, I have nothing to offer. It lies outside of this discussion.

A cursory reading of the first Chapter of Genesis, waiving for the moment the question of its truthfulness, shows it to differ from other works in Natural Science, in this. It has no theories to support, offers no explanations, formulates no law. The facts are related, but there is no attempt to coördinate them with each other, or with other facts. In this it resembles a series of photographs.

The more obvious purpose of the Author seems to have been the removal of all excuse for idolatry or other form of polytheism, which at that time manifested itself in the worship of Sun, Moon and Stars, of Earth and Sea, of vegetables, and of almost all organic life. This was done by representing God (Elohim and the Jehovah Elohim) as creator of all things, and, with special emphasis and repetition, as the maker of Sun, Moon, and Stars, the disposer and appointer of these, the principal objects of idolatrous worship. To impress this truth upon the race, the Author inculcated the observance of a seventh day of cessation from labor, as a memorial of God's creatorship and a perpetual protest against other gods.* So important, in his opinion, was this arrangement by

* A disquisition upon the advantages of the Sabbath would be out of place here. I wish only to call attention to the perfect adaptation of the means to the end in view. If this day had been observed for the reason assigned in the fourth Commandment, idolatry, whether ancient fetichism or more modern pantheism, had simply been impossible.

seven days, that he compressed fifteen distinct creative acts into six creative periods.*

Another purpose underlies this Account, not so obvious, but as it seems to me, none the less real; it was to authenticate this revelation to future ages, "when men should run to and fro, and knowledge be increased." Consequently, the Author displays a mastership of his subject, a wealth of knowledge, altogether superfluous, if the object previously mentioned was the only one in view.

Whether these purposes will appear of sufficient dignity to have a place in a divine revelation

* List of Divine formative acts in both chapters before the close of the sixth day.

Chapter I.	v. 1.	God created heaven and earth.
"	v. 2.	" imparted motion.
"	v. 3.	" made light.
"	v. 4.	" divided light from darkness (made day and night).
"	v. 7.	" made the "firmament."
"	v. 9.	" made the dry land appear.
"	v. 11.	" made the earth bring forth grasses, herbs and fruit-trees.
"	v. 14.	" made the seasons.
"	v. 21.	" made the fish and fowl.
"	v. 25.	" made cattle, beasts, etc.
"	v. 27.	" made man.
Chapter II.	v. 8.	" made the garden.
"	v. 9.	" made to grow all trees good for food and pleasant to see.
"	v. 19.	" made every beast of the field and every fowl of the air.
"	v. 22.	" made Woman.

of a matter so great as the creation of a world, will much depend upon our ideas of man's place in the scale of being. But this is a question only as to the good sense and taste of the Author, and does not affect the truth of his assertions.

Nor is it a just ground of objection that his statements are not made in scientific language and with scientific exactness, for the latter is not true, as I shall hereafter show, and as for the former, the laws and terminology of Astronomy, Geology and other sciences were then unknown. It would have been necessary to create scientific terms for this special purpose, and from that time to the present century they would have been unintelligible.

Is it indeed certain that an absolutely correct terminology would even now be understood? Has all knowledge been so thoroughly explored that nothing remains to be added to, or taken from, the present laws and nomenclature? Were Newton to take up a modern Scientific book, he would find much to perplex him, old terms used in new senses, and new ones that would convey no meaning. Should the Scientist of to-day revisit the world a century hence, is it probable that his experience would differ from that of the great English Philosopher?

Not only was a statement of phenomena the only method of imparting information on these

subjects possible under the circumstances, but it was the best method conceivable under any.

The value of an accurate statement, photographing, as it were, the phenomena of nature, can never be fully known by finite minds. Facts whose scientific value has apparently been exhausted, like the rejected dross of ancient mines, may, in the crucible of modern analysis, prove rich in precious metal. Others of apparently trifling importance may, under different subjective conditions, be "the very article of a standing or falling" theory.

The apparently accidental noting of a star one night many years ago, and its appearance in another position a few nights after, a change attributed by the conscientious astronomer to some error of eye or hand, but both of whose places he fortunately put upon record, with an interrogation marking his doubts and the probably valueless character of such an observation, lay dormant many years. Its value, had he suspected it, would have been more to him than all the labors of his life, but would have deprived Le Verrier of the glory of his discovery. Not till the world had rung with the wonder of that marvel of analysis, and astronomers had set to work to discover whether Le Verrier's calculated elements were true, did the pregnant meaning of that "trivial fact" become known. It might have revealed

the planet's existence years before, but even now it fixed the true elements of its path.

Accurate descriptions of phenomena are the meat and drink for which every student of nature hungers and thirsts. It is solely for these, that governments fit out expeditions to observe eclipses and transits, and to dredge the ocean bottom.

In the Mosaic Narrative, facts are related in the ordinary language of life, which all men can understand, and it is no proof of their untruthfulness that they carry to each reader a meaning larger and richer in proportion to his knowledge and capacity. On the contrary, this is a characteristic mark of any truthful statement of phenomena.

It is easy for a child to understand that the eclipses of Jupiter's Moons occur sometimes eight minutes sooner, and sometimes eight minutes later than by previous calculation they ought, a fact to him curious perhaps, but of no great consequence. To the philosopher, however, that fact made known the velocity of light, from which was obtained the measurement of its waves, on which is built up the Science of Optics. So, too, a child can understand that the planet Uranus rises sometimes too soon, and sometimes too late, a matter to him of small importance. But this same fact told Le Verrier of a planet outside of Uranus.

Such simple statements, pregnant with truth, abound in this account. It was indeed, "not

intended to teach us science," any more than the apparent irregularities of Jupiter's Moons to teach Optics, or the perturbations of Uranus to teach Astronomy; but, if true, it is more than Science, it is the material of which Science is made.

There has grown up in many minds the belief that, according to Moses, the world and its contents were formed in six ordinary days. It is on this supposed statement that most of the arguments against the truth of Genesis have been based. It has been assumed that such was the true meaning of the Narrative, and then shown by admitted Geological evidence, that the world and unnumbered races of animals and vegetables have existed for countless ages; and that a process of slow development has been going on for millions of years. The Bible, we are told, may be the work of man, and therefore may not be true, but the Geological record is independent of man, and therefore cannot be false; hence, in an issue of fact, we must decide against the former. The conclusion is unavoidable if we admit the premises.

But did the Author intend us to understand that the world and its contents were created in six ordinary days? Or, if you please, did he say or desire us to believe that, from "the beginning" to the close of creation only one hundred and forty-four hours elapsed?

I answer emphatically, No.

But the reasons for a negative answer cannot

well be given, so interwoven are they with the Narrative, until that has been considered. The reader is requested therefore to wait until we have gone together through it, when the duration of the Mosaic Days will be again taken up, and, as far as in me lies, exhaustively discussed. I hope then to show that the literal truth of this Narrative harmonizes perfectly with the existence of the immeasurable epochs of Geology.

I may, however, now properly call attention to the remarkable circumstance that, although so much has been said and written on the assumption that this world and its contents were made according to Genesis in six days, there is no such statement to be found in these two chapters. If I am wrong, it will be easy to point out the verse in which it is. I am unable to find it.

The only allusion to the duration of the creation, is in the fourth verse of the second chapter, where we read "in the day the LORD God created the heavens and the earth"—one day, not six days.

Nor is it said that any creative act occurred *on* any of the days. It may be implied, perhaps it is, but certainly it is not so *said*. The wording is very peculiar, and like everything else in these chapters shows design. Remember, the question is not what we think or infer the writer intended to say, but what did he actually say? On this I shall have more to offer hereafter. The other parts of the Bible are outside of our present discussion,

yet as showing the mode of speaking, the *usus loquendi*, I add that although the wisdom, goodness, and power of God as manifested in Creation are often alluded to in other parts of it, yet none of its many writers speak of its brevity. On the contrary, there seems to be a purpose to break up the ordinary notions of time as applied to God's works. We are told "a thousand years are as one day, and one day as a thousand years."

I have not forgotten the text so often quoted to prove the instantaneous performance of God's commands, but I can see in it only obedience, and no reference to the time employed. "He spake and it was done." Certainly He spake, and it *was* done, but I do not acknowledge the right to interpolate any modifying word, even though that word be "immediately." Shall we never have done adding our beliefs to the Word?

"Firmament," something solid. This word offers no difficulty, since it is admitted on all sides to be an improper rendering, to suit the Science of Ptolemy's day. The Translators, unable to comprehend the Science of the Bible, forced it to say what seemed to them in harmony with the laws of nature. They could not believe in a mere expanse or open space—it was contrary to all their Science—and therefore they translated "expanse" by "a firmament," something solid to hold up the sky!

Having disposed of the objections urged against

this Narrative, on account of its phenomenal character, and the absence of scientific forms and terms, and passing by for the present the supposed assertion of the brevity of creation, we turn now to examine the Book.

In the spirit of a student anxious only to discover the truth, and in the full assurance that all truths are harmonious, I shall seek to learn what the Narrative says, and what is almost equally important in maintaining its Divine origin, to point out certain things attributed to it, but which it does not say. At present I shall speak almost wholly of the latter.

I find that it mentions very briefly, in a certain order of occurrence, some of the most important events in our world's history, but that it is silent as to everything else, resembling that kind of history styled Annals. It opens with a statement of God's universal creatorship. It then commences a series of details, beginning with the primordial condition of the earth, and ending with the Creation of Man. Passing this by, let us now see what it does not say.

It says nothing as to the previous existence or non-existence of older orders of beings, such as the animals and vegetables of the Paleozoic Age, nor of those upheavals and depressions which have left their record in the contorted strata. As to the latter, there can be no difference of opinion; the text certainly says nothing of them.

But as to those plants and animals of previous ages, which we now know were extinct when man appeared, Moses does not speak, for he makes mention of "grasses, herbs, and fruit trees." They did not exist in the earlier periods. The peculiar vegetation which marks the dawn of organic life, shows only plants of the lowest orders, as Algæ, Ferns, etc.

These can by no possible classification be included among the plants mentioned above, which, as Geology tells us, appeared long afterward, long even as Geology counts time.

So too in regard to animal life; for ages after ages, were found in all the vast round of our globe, in the ancient waters of its seas, or sporting on their shores, only mollusks, radiates, and articulates. Not a vertebrate, much less a mammal, yet lived. Such a fauna does not correspond with that described as "cattle, creeping things, and beasts." The latter fauna harmonizes perfectly with the animals of to-day, among which we find not merely mammalia preëminent, but also an abundance of species of all the lower orders. Moreover, the text, with its usual careful wording says, "the moving creature that *hath* life," and "every *living* creature," i. e. not the extinct, but the present living species.

On the other hand, the Account gives no ground for the assertion that these extinct species came into existence independently. It merely does not speak of them at all.

The Account taken thus narrowly and literally harmonizes with the facts of Geology. It is only by extending it beyond its own words, a very undue liberty as it seems to me, that we find a difficulty in the fact that according to the fossils, not one of the "grasses, herbs, and fruit trees" preceded animal life.

Such a conflict, however, is of our own production, for the Account carefully limits the kinds of plants which it affirms preceded the animals of the fifth and sixth periods, and the evidence of the fossils corroborates its assertion.

Although it may, at first, appear that all creatures living during the fifth and sixth periods, were, according to Genesis, formed during those periods, yet on a more careful examination it will be found that there is nothing in the text to forbid the belief (should there be grounds for it) that species of previous creations were still in existence, nor that some may have come down to the present day. The Account neither affirms nor denies.*

* I leave it for specialists to say whether life of any kind passed over the great convulsions that marked the close of the Paleozoic Age or survived from the Mesozoic into the Cenozoic, or lived through the cold of the glaciers. In general, life was destroyed, although perhaps some Protozoans, and possibly a mollusk or two, may have escaped through them all. It is doubtful whether *any living species* is identical with the fossils of a period earlier than the Eocene. "Of living fishes, reptiles, birds, and mammals," none can be traced back as far as the Tertiary, the yesterday of Geology. "All the fishes, reptiles, birds, and mammals of the Tertiary are extinct species." (Dana's Manual, p. 518.)

The first two Chapters of Genesis do not tell us how long it is since Adam was created, whether it is 6,000 or 6,000,000 years. They do not profess to give any information about it. Whether we can justly deduce this period from some other portion of the Bible, is not a question that concerns this discussion. If every word of that Book save the Mosaic Narrative were dropped out of existence, the truth or falsehood of the latter would not be affected. It merely places man's creation upon the last of the six great epochs, as the crowning glory of the whole.

The text does not say, that no species of plants or animals were created after Adam and before the "rest" of the seventh day. On the contrary, it appears to be clearly intimated in the next Chapter, that "all kinds of trees pleasant to the sight and good for food" were made *after* the creation of man, as well as all kinds of animals for him to name.

In conclusion.

It is just and logical when examining into the truth of statements contained in any document, to see exactly what it says, and consequently it is unjust and illogical to condemn it for the glosses and explanations that may have gathered about it.

The Mosaic Narrative does not tell us the duration of the process of creation, except so far as to let us know it was not instantaneous, since it occupied a time in which were "six days" of completion and approval.

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It does not affirm that each act was instantaneous, as when, e. g., God said, "Let the dry land appear," that at once, like the palaces in stories of Eastern Magic, it rose from the bottom of the sea.

It does not say how much or how little time elapsed between the events mentioned, as from the Creation of Light, to its separation from darkness.

It does not speak of the creation of Algæ, Ferns, and the early Flora.

It does not deny the existence of species coming down from more remote epochs.

It does not deny the creation of plants subsequent to the third day.

It does not deny that animal life began long before living species of fishes, fowl, beasts, creeping things, and cattle.

It does not deny the possibility of some species having survived from the dawn of organic life.

It does not say how many years have elapsed since Adam's creation.

Of most of these matters, it says nothing at all. Its silence on any question, cannot justly be interpreted as affirming or denying. Anything outside of its own words, does not attach responsibility to it.

The fact that this Account is not clothed in scientific language, is not only no argument

against its truthfulness, but so far as it goes, decidedly the opposite, since a "phenomenal" statement, a series of "logographs," * is immeasurably richer in meaning and more fruitful in results than any other method of imparting information of which we can conceive.

If these conclusions are correct, then it readily follows that any argument based upon the opposite assumption is wholly irrelevant.

This ruling will throw out of Court nearly all the testimony brought against the truth of this most remarkable document.

* "Logograph," a word bearing the same relation to a "description" that a photograph bears to a pencil sketch. No word in our language conveys the intense literalism of this Narrative

CHAPTER II.

THE UNITY OF GENESIS AND SCIENCE.

TESTIMONY OF NEW WITNESSES.

"THERE is no mode of establishing the validity of any belief except that of showing its entire congruity with other beliefs."—HERBERT SPENCER.

EVERY one that has watched the operation of his own mind, has noticed that his judgments are affected by impressions received early in life, and this too, in spite of the more correct information of later years. In childhood, we believed all the heavenly bodies were equally distant from us, and now, notwithstanding our present knowledge, how many of us can *see* that the stars are ten thousand times more remote than the moon?

When we have repeatedly read of events placed in close proximity upon the printed page, we are very apt to think of them as actually occurring at correspondingly short intervals. Impressions thus formed influence us long after we have learned better. It is absolutely necessary to get rid of them and to cultivate a sense of true

historical perspective, if we would attain any correct comprehension of the past.

Were I to tell a child that Alexander, Hannibal, and Cæsar are the greatest generals the world has seen, he would think of them as living at one time. If he is logically inclined, he will maintain that they are now living, or that my assertion is false, for did I not say, "are the greatest generals"?

But as his knowledge of language increases, he will admit that my statement is not inconsistent with the fact that they are all dead; and as his acquaintance with the history of the past expands, so will their respective epochs appear to separate, till in after years each takes his proper place in the long line of events.

In writing a very brief epitome of history, I might say: "America was discovered by the Spaniards, by whom the most of South America and a large part of North America were settled. The English made settlements at Jamestown and Plymouth. The colonists made war on the mother country and obtained their independence. They had slaves before and after this, which resulted in another war, after which there were no more slaves."

In this little narrative there are between the clauses great intervals of time, in which many interesting and important events occurred. Nor is this any impugnment of its truth. It makes no

pretence of telling anything more than the words say. It states such facts in the order of their succession as seemed to the writer best to be recorded, and neither affirms nor denies anything in regard to what may, or may not, have taken place besides, and it would be strange logic that should infer its falsehood from such silence.

Such is exactly the character of the Mosaic Narrative, and to properly understand it, one must divest himself of early impressions as to the immediate and rapid succession of the events there recorded, at least so far as to leave his mind unbiased by their juxtaposition upon the page, or by previous theories.*

Those who have either cut themselves loose from all early "theological" training, or who never were imbued with the traditional belief in regard to the close succession of events mentioned in the Mosaic Account, may be at a loss to understand the difficulty others experience in stereoscoping the past. Reason here must be aided by a positive effort of will. Perhaps one more illustration may aid the latter in the attempt.

Suppose the scenes of earth ended, and that some spirit in the far-off eternity should relate to a new-comer the story of our world.

He might, in brief phrase, tell of creation and

* For an exhaustive examination of texts succeeding each other without notice of interval of time where we *know* from statements elsewhere there was such interval, see Genesis and Geology, by Denis Crofton, B.A.

man's trial and fall; of the Serpent and the mysterious promise, "And I will put enmity between thee and the woman, and between thy seed and her seed; it shall bruise thy head and thou shalt bruise his heel." Then he might add, "and it was so, the Seed of the Woman did bruise the head of the Serpent, did overcome him, and myriads now in this abode are the trophies of his victory."

The listener, ignorant of the thousands of years of wretchedness and misery while the Serpent seemed triumphant, might most naturally infer that the triumph followed close upon the declaration. But, for us, it is easy to see the ages that elapsed between the promise and the time when it could be said, "and it was so."

The history of creation occupies only the first chapter of Genesis. It is followed, in the second chapter, by a brief summary of the whole work, and a more special account of the occurrences of the sixth period.

I propose to confine myself, at least for the present, to the first and apparently more systematic statement.

Any difficulties outside of this may or may not prove formidable, but their discussion has no bearing upon the truth or falsehood of this narrative.

The Bible abounds in the rich poetical imagery of the East; but this first chapter is the most

literal prose, a record of hard, dry facts. In mathematics one speaks of roots and powers, in natural history one reads of kingdoms, classes, and orders, but this narrative has an absolute realism that is wonderful. Such at least it appears to me, and as such I propose to treat it in this discussion.

The account opens with the all-embracing declaration: "In the beginning God created the heavens and the earth."

It assumes the existence of a First Cause,* whom

* It is interesting to note that Scientists who have prided themselves upon their superiority to all claims of supernatural influences and revelation, have arrived by their own road at the first verse in the Bible. Prof. Tyndall, in the opening Address to the British Association, is reported to have summed up in the following words:

"In fact, the whole process of evolution is the manifestation of a Power absolutely inscrutable to the intellect of man. As little in our day as in the days of Job can man by searching find this Power out. . . . There is, you will observe, no very rank materialism here."

What is this but a scientific paraphrase of "God created the heaven and the earth." The inscrutability of this Power was as well known to Moses and to Job as to Prof. Tyndall or Mr. Spencer.

The identity of the two propositions is the more striking when it is remembered that Moses wrote, "In the beginning *Elohim* created the heaven and the earth," and *Elohim* means "powers." Would the modern philosophers have suffered any loss if they had taken the word of Moses and Job, that it was an Inscrutable Power that "evolved" the heavens and the earth?

For the further consideration of this word, *Elohim*, and the personality of the narrative, see Part II.

it styles God, an assumption which it does not base upon any argument, but appeals to each reader, as to a matter within the view of his own consciousness as absolutely as the existence of the material world. There I leave it, only adding that matter, or mind, or both, must be eternal, and that I find it logically easier to conceive of one self-existent and eternal Being than of two or more.*

There is at this day prevalent among certain writers a peculiar state of mind characterized by an instinctive aversion to the use of the word "God," which for lack of a better name may be styled Theophobia. It manifests itself in the use of some impersonal word, as Law, or Force, or Evolution, or Power, or "Dynamis," and if compelled to use the name of Deity, spells it "god."

Moses has no such theophobia. He delights to place the name of God in the front of every sentence.

His is a personal God, who not merely enacts laws for the universe, but executes them—not merely sets the machinery in motion, but, as it were, stands by and notes its working, and as his plans develop, pronounces each completed stage of progress "good," and when he has crowned all

* I use the term "self-existent" for lack of a better. That which exists without a beginning is *existent*, not *self-existent*, since the latter implies self-causation, i. e. self antecedent to itself!

I know of but one absolutely logical expression for such a Being: "I Am." "'I Am' hath sent thee."

with the creation of man, styles it all "very good."

Science cannot go back to the opening of this chapter. It takes cognizance only of what has occurred since that "beginning." Yet it has discovered many indications that the present order is not eternal. The transmission of light, the retardation, and breaking into fragments of comets, indicate an interstellar medium which is slowly bringing the planets to rest. The friction of the tidal wave, given time enough, will stop the diurnal motion of the earth. The sun is slowly losing its heat. Now, however small these retarding forces, or however small the loss of heat, yet, if they had operated "from eternity," it is a proposition easily demonstrated that the momentum of the earth, and the heat of the sun, would have been exhausted ages ago.

Science then clearly demands a "beginning." Starting from that, many wise men have sought to expound the mystery of the universe, or at least to show how our own system might have been developed under the influence of forces still active.

Assuming the existence of matter and motion as the result of attraction, without attempting to account for either, Laplace some fifty years ago proposed the well-known Nebular Hypothesis, which by its accordance with the facts of our solar system, has passed from the domain of theory, almost if not wholly into that of law—a result

which has been confirmed by the discoveries made in the last few years by aid of the spectroscope.

The central fact of this theory is, that the solar system, and of course the earth as a portion of it, in its primordial condition, was a shapeless, empty, dark collection of highly attenuated matter, or in modern technical phrase, a nebulous mass.

Nearly four thousand years ago, Moses, giving an account of our earth, describes its condition prior to the commencement of motion, in language almost identical. He says "the earth was without form and void, and darkness was upon the face of the deep." * It was not the firm, solid globe which we now regard as the ideal of stability, but a something mobile, something that flows, "waters" in the language of those days, a "fluid" in the nicer definition of the present.†

* The received version "without form and void," was in the main acquiesced in until the exigences of certain theories required a modification of meaning. (See Lange, Genesis, p. 163.) After a careful reading of the argument *pro* and *con*, I still adhere to the old version. But in every rendering there is the same idea of organic emptiness, and of matter in a state of shapeless disorder.

Did, however, this phrase stand alone, I should not found an argument upon it, but the evidence is cumulative. It is not the coincidence of one or two expressions, but the harmony that runs through the whole narrative.

† I doubt if any language, until a comparatively recent period, could express the nice distinction between "fluid" and "waters."

Indeed, the Hebrew word is radically much more closely allied to "fluid," being derived from a root that signifies "to flow."

Is it possible even now, to describe in more appropriate words, the nebulous condition before the mass was vivified with motion? "Without form," shapeless, empty, dark, not solid, but flowing, "waters," or fluid.

Of *forces* we know nothing, but use the word as a convenient name for that which causes or opposes motion. Of their origin Laplace's theory takes no account, nor can the Science of to-day do more than to refer it to the same First Cause as matter.

And in this conclusion, Science accords with the statement in Genesis; God, "the First Cause," is the first mover. "The Spirit of God moved upon the face of the waters," i. e. the fluid mass.

To this brief assertion, Science can add nothing. This region also lies beyond its domain.

But from its vast store-house of facts it has drawn this generalization which corroborates the idea that appears to underlie these first two verses, namely, that the primordial order of existence is mind, matter, and force, and that matter, modified by force, is that which is the present physical universe.

"Many of the most eminent physicists of the present time see in the cosmos, besides mind, only two essentially distinct beings (*sic*), namely, matter and energy, and regard all matter as one, and all energy as one, and refer the qualities of substances to the affections of the one substratum,

modified by the varying play of forces." (Page 102, New Chemistry, Prof. Cooke.)

Such a generalization implies, or rather requires that matter existed before the application of force could develop anything, and that there was for them a unity of origin. This corroboration is the more interesting from the utter unconsciousness of Science that it exists.

Prof. Tayler Lewis says the primary meaning of the word translated "moved upon," is to flutter (regular pulsatile motion), and the verb being in the Piel conjugation makes the inward sense of the throbbing more intensive. The reader will here note a singular harmony with the modern scientific belief that atomic vibrations lie close to the foundations of all the forces of nature.

Furnished now with matter which has been endowed with forces, Science, like the old Geometer, can move the world. Thanks to the newly discovered law of the correlation of forces, philosophers can now tell with absolute certainty what was the first visible effect that followed motion. As the telescope carries us out into the depths of space, so this last and grandest generalization takes us back into eternity, enables us to note the very foundations of our world, to trace the atoms in their paths, and, as they dash together, to see the darkness lit up by the new-born light. It tells us that heat and then light were the results of these primordial movements. The hitherto "formless, empty, dark"

mass became self-luminous, and the surrounding ether joyously trembling, bore in eager haste the news to neighboring systems that another was added to their number, and then, "the morning stars sang together, and all the sons of God shouted for joy."

Till within a generation, Science in her wildest dreams could not have told us this. But Moses put upon record, nearly four thousand years ago, as the next step after the impartation of motion in this making a world, "God said, Let there be light, and there was light."

Note the coincidence. This third step placed upon record so many thousand years ago, is precisely that called for by the Nebular Hypothesis and the Correlation of Forces.

According to Dr. Adam Clark, the word rendered "light," signifies not light only, but heat or fire.

This identity of signification is, to say the least, exceedingly appropriate, since light and heat, as we now know, are generically one, being merely variations in the ethereal undulations, a physical fact unknown to Dr. Clark!

The primary, nebulous condition, "without form, void and dark," was utterly unfit for human use, not a condition complete in itself, but preparatory for something higher. Hence, in harmony with the Author's dominant idea of making man the central object, it was not pronounced "good."

But as light was perfect in itself, ready for the use of the coming man, irrespective of the state of what it illuminated, it merited and received the verdict of completion and approval. "And God saw that it was good," finished to his satisfaction.

By the laws of dynamics aided by a knowledge of "the correlation of forces," we now know that the hot, self-luminous, nebulous mass of our solar system (the cosmos) slowly cooled, and shrinking centreward, generated a gyratory motion. Revolving with increasing velocity as the diameter grew less, it at length left behind it nebulous rings, which themselves cooling and shrinking, formed the planets. Our earth, gathered up from an annular to a spheroidal form, was at first a mass of incandescent, self-luminous vapor, as it were a comet, revolving about the central body, in a planet's orbit. Further condensation and cooling made it a ball of liquid fire, a shoreless ocean of lava, giving out light upon every side.*

* "And what a surface! For land and water, glowing rock and molten lava. Vast seas of fire tossed by furious gales whose breath was flame, corruscated with a thousand colors as their condition underwent continual change. Then over a wide extent of those oceans the intense lustre would die out, to be replaced by a dull, almost imperceptible glow where the surface of the fiery ocean was changing into a crust of red-hot rock. But then came fresh disturbance. The crust broke in a thousand places, showing the intensely hot sea beneath. Fragments of red-hot rock many miles in extent were tossed hither and thither by the raging sea. Nor were these the only evidences of an intense energy. From

Still slowly cooling through the ages, its surface became covered with a solid but glowing crust, and when this had so far fallen in temperature as to be no longer luminous, then, for the first time in the history of our globe, the hitherto all-pervading light was separated from the darkness, as now, by a line of demarcation, on one side of which opposite the sun was night and on the other day.

"And God called the light Day, and the darkness he called Night. And the evening and the morning were one day." ("One day" in the Hebrew.)

This marks an important stage of progress in our world's development, indicating the complete transition from the gaseous, self-luminous, cometary condition, to the solid, opaque, planetary body, a fact that was evidently well known to the Author of Genesis, for in his brief way he mentions the division of light from darkness, *the* fact which of all others characterized it, a division heretofore impossible. "And God divided

time to time, the rush of the hurricanes which raged over the molten oceans, was hushed into comparative stillness, as volcanic explosions took place. Enormous volumes of steam and other imprisoned gases were flung upward with irresistible force."

This vivid picture, from Proctor's Borderland of Science, although an imaginary description of Saturn, is a true description of our earth's condition after it had condensed to a liquid and had begun to form a crust, but was yet self-luminous.

between the light and the darkness." Up to that time, in reference to our planet, light had been everywhere, and there would have been no more propriety in speaking of such a division than there would be now in case of the Sun.

Could any man, in the light of the present knowledge, select more accurately, or depict more graphically, the characteristic fact which indicates the close of our world's intensely hot and self-luminous existence?

Note, too, the thorough mastery of his subject, incidentally, as it were, shown by the Author when he calls "day," not the light in general, but light after this division. It was not the darkness which was upon the "deep" prior to motion, but darkness which had been separated from the light, that he called Night, i. e. it was after the earth began by alternations of light and darkness to measure time.

In these two verses (4, 5) is comprehended all that the Author has seen fit to tell us of our world's self-luminous existence. The announcement of the emission of light, "And there was light," marks the earliest visible effect of Cosmic vivification by the impartation of motion, the commencement of that period of intense heat, and universal luminosity, as the words "God divided the light from the darkness," mark its close. Between these verses is all the long time from a first moved cosmic mass, to a solar system with its arrange-

ment of Sun, planets, and satellites, to our earth a solid non-luminous sphere! So vast an interval, so transcending the power of the human intellect to measure, which no Calculus can compute, bewilders us, and we draw back exhausted as from the contemplation of duration without limit.

Such vast real intervals, where there is apparent juxtaposition, are most common in the record written in the sky. Stars seem to us almost to touch each other, whose real distance apart is unmeasured, and as yet immeasurable. In an infinitely smaller way, writers and speakers often link into one narrative, or even one sentence, events separated by vast intervals of time. If one were to say, "Italian Tribes founded a city, which Gothic Robbers destroyed," the statement would be equally true whether we recognized the many centuries that intervened, or in our ignorance, thought that the last event followed close upon the first. And when, our knowledge of history having increased, we learned how far apart they really were, it would be strange logic that should therefore deny the truth of the original statement.

Important as was this stage to which our world had now attained, it was a condition of transition, not of completion. Although no longer hot enough to give light, yet for a long period its high temperature permitted no water to remain upon it. The Oceans existed at first as superheated, transparent vapor. But as the surface

heat grew more moderate, the invisible vapor became dense masses of mist enveloping the world "in clouds like a garment," and making "thick darkness a swaddling band for it." This mist, or cloud, must have been of vast extent. If we suppose one cubic inch of water to form one cubic foot of vapor, and the ocean sufficient to cover the earth to the depth of two and a half miles, the "clouds" must have been nearly two thousand five hundred miles in thickness, causing a "darkness" more intense than the darkest night imaginable.*

* The Bible student will note this as one of the many instances in which Science casts a flood of light on passages otherwise incomprehensible. What more beautiful and true description can be given of that condition of our earth which we have been been considering, than the one in Job, xxxviii. 9? These dense masses of clouds! how they must have poured down the water as they passed more and more completely from invisible vapor to clouds and mists!

"Or *who* shut up the seas with doors, when it brake forth, *as if* it had issued out of the womb?

"When I made the cloud the garment thereof, and thick darkness a swaddling band for it."

Think of the intense, all-pervading darkness caused by such clouds; making "the cloud the garment thereof, and thick darkness a swaddling band for it!"

"A swaddling band," not an irregular, shapeless mass of clouds, but "bands" wrapping it around, as to-day clouds wrap around Jupiter and Saturn.

Their waters are still in their atmosphere, but mostly, as I take it, yet in the form of invisible superheated steam. Their ground is still hot enough to glow. Their clouds (of whatever material) are yet in "bands" about them.

Such in an earlier epoch was the condition of our planet, and such, as far as the bands, it continued after it passed into

Further ages of cooling reduced the temperature of the vapor until, at length, the water began to descend in torrents, to be again and again thrown back in clouds of steam by the hot crust. In due time the conflict ceased. The primeval storms and tempests abated; the air became clear. The waters covered the earth; above them a transparent open space, and yet above that, clouds. This open space marks the close of another important stage in the progress of the world toward inhabitability. It indicates the close of the supremacy of purely igneous action, and the beginning of the period in which aqueous action was henceforth to be dominant.

The Author of Genesis must have known of this, or he would not have given us in this series of word pictures, as representing the next great stage of progressive development, an open space which separates the rolling ocean, "the waters below," from the clouds yet suspended high in air, a space so clear that one could see in the blue expanse the glories of the heavens. These are his words: "And God made an open space (not στερέωμα, nor firmament, something solid, as translated by Scientists of Ptolemy's time!), and divided the waters that were under it from those above it."

the condition of lower temperature when water became visible mist. Even now, were our earth free from inequalities upon its surface, its clouds would retain their band form. Land and water, mountains and valleys, destroy all regularity of cloud-form.

And this "open space God called *heaven*." Why? Because, as we now know, it was only *after* the deposition of the water that the stars were visible on our globe. During its earlier stage, when itself luminous, the fainter light of the stars was either lost in the earth's own effulgence or quenched in the vapors that loaded its atmosphere. During the non-luminous condition, their light was intercepted by the dense clouds. Hence when there came the open clear expanse, it revealed for the first time the glories of the night, and seemed as now to reach the stars. Indeed, if one wishes to be very exact, he may justly say, the open space which separates the waters is the same space which continues beyond the clouds, to the heavens, to the stars themselves, an interpretation that, to say the least, is not opposed by the fact that the word rendered "heaven" is dual in form.

This clearing the atmosphere, science tells us, was a very important stage of progress; indeed, absolutely essential to the subsequent development. That the Author appreciated its importance is evident, since he devotes a "day" to it. But he does not pronounce it "good."

Why this omission? Certainly the work was of inconceivable importance, absolutely essential before life could exist, and there is nothing done by the Divine Architect that is not well done.

I think it is manifest on a careful study of

this Chapter that in every case where it is said "God saw it was good," perfection is indicated, i. e. not excellence only, but completion—"good" for the use to which it was to be put,—"good" for men.

For some cause, the atmosphere, the clear, open expanse, although freed from the excess of water, was not pronounced finished for the use of the coming man.

The records of Geology offer an explanation. There we find abundant and convincing evidence that the purification of the atmosphere was not completed until unnumbered centuries after the beginning of the upheaval of the dry land. At least through the Paleozoic epochs (a duration we cannot measure), the air was loaded with carbonic acid and probably with many other impurities.

Had the Author represented the purification of the air, not as having reference merely to the deposition of the water, but as continuing until he was able to pronounce it "good," i. e. fit for man, he would have materially injured the sharp chronological order which is one of the most characteristic features of the Narrative, since this would have carried the "second day" so down into the history of the globe as to have lapped far on the emergence of the dry land, the work of the next great epoch.

How long the world remained enveloped in a shoreless ocean there are no data on which we can

found an estimate. It must have been a time of turmoil, of great volcanic upheavals, of terrific earthquakes. It must have been long, for during its continuance the primeval crust was broken and ground up, forming in part the materials of the Azoic sedimentary rocks, as is apparent from their immense thickness.

In the fulness of time, the continents began to be upheaved, showing in their earliest manifestations lines of structure which clearly indicated their present form, bearing no marks of chance upheaval, but showing a plan worked out through the Geological epochs, and attaining their full completion, after countless centuries, towards the close of the Tertiary.

In this Age (Dana, p. 586), "there was the finishing of the rocky substratum of the Continents; the expansion of the continental areas to their full limits, or their essentially permanent recovery from the waters of the ocean; the elevation of many of the great mountains of the globe, or a considerable portion of them, through a large part of their height, as the Alps, Pyrenees, Apennines, Himalayas, Andes, Rocky Mountains, the loftiest chains of the globe,—a result not finally completed until the close of the Tertiary."

Geology, then, tells us that at the close of this epoch, the arrangement of the land was completed, and the profoundest students of Physical Geography unite in pronouncing it "good."

In perfect accord with this, the Author places in an epoch subsequent to the deposition of the waters, the appearance and the completion of the dry land, and adds, "God saw it was good." He gives no intimation of the interval of time between, but Geology so far supplies the omission as to assure us of its surpassingly long duration.

It may be replied that in all this there is nothing remarkable, as of course the elevation of the land above the water could not have preceded its deposition. Yet I note three things that did not "follow of course."

First, The land might have assumed its present elevation before the water fell, leaving the latter, when the time for falling came, simply to fill the already existing valleys to their present depth. But the words, "Let the waters be gathered into one place, and let the dry land appear," are utterly inconsistent with any such previous condition, and are equally in harmony with all the Geological facts of the world's history.

Second, It was the belief of the ancients that the world was mostly land, and the water comparatively small bodies in a great degree isolated from each other. It did not "follow of course" that the waters were gathered into *one* place. Yet such is the fact, as Geography tells us.

Third, The excellence of the arrangement of land and water does not "follow of course." The ancients had a horror of the sea, and it is only

since a comparatively recent date that Scientists have found that land and sea have been placed and proportioned with surpassing wisdom.

The Author of Genesis pronounced it "good," and now all science confirms the verdict.*

I cannot leave this portion of the account without calling the reader's attention to its peculiar wording. "Let the dry land appear," or if it is closer to the original, let it be written as a future (since the Hebrew obtains its first and third persons of the imperative by the use of a simple future). "The dry land shall appear." Such an expression would be marvelously in harmony with the fact that the land had risen close to the surface

* It will aid in appreciating the wonderful wisdom of the Author of this Narrative to compare his statements with those of a much later Hebrew Author.

In II. Esdras, chap. v. 42, in the course of an account of Creation borrowed from that in Genesis, the writer, not satisfied with the Science of that book, attempts, like the translators of the Septuagint, to improve it by the aid of the improved Science of his own day. He says, "Upon the third day thou didst command that the waters should be gathered in the seventh part of the earth; six parts hast thou dried up, . . . the seventh part where the waters were gathered."

This is far from being the only instance of the danger of adding improvements to the story of the Hebrew Prophet.

Such blundering was most natural to one whose knowledge was limited to the waters bordering on Judea. His statement contrasts most sharply with the brief but photographically true account of Moses.

of the water, all shaped and planned, and only waited the permission to rise through the shallow covering of water to the air. "Let the dry land appear." It is all ready, let it come forth.

What, then, is the fact as revealed by Geologists?

That at the beginning of Geology, the continents were formed as immense submarine plateaux, lying a very short distance beneath the surface. The grand structure-lines of the continents were early formed and "the system thus initiated was the system to the end." (Dana, Manual, p. 160.)

There is something marvelous in the sharp antithesis of the Mosaic account, "Let the waters be gathered unto *one* place," and the immense inland seas of the earlier Geologic Epochs, an antithesis that finds its counterpart in the actual contrast of those periods and of to-day.

The then condition of our earth resembled that exhibited now upon the planet Mars according to the latest maps, on which are seen large bodies of water shut off from all others, and with long, narrow arms running far inland.

Sir R. Murchison tells us that "Russia in Europe is one huge depository basin," . . . "there existed an inland sea of brackish water exceeding in size the present Mediterranean, of which the present Caspian is the diminished relic." This inland sea, he says, was entirely separated from the Western Ocean of that period.

Vast shallow inland seas, at times connected with other bodies, and at other times entirely cut off, were numerous in the period preceding the middle Tertiary, and to some extent till towards its close.

The reader will note that this is the Geological epoch of the completion of the continents, and of the appearance of "grasses, herbs, and *trees* bearing fruit whose seed is in itself," and that it immediately precedes the period of the Glaciers, that period which draws a strong line of demarcation between the ancient type of climate and the modern.

The Mosaic Narrative now deals with organic forms, and first with vegetation.

Let us see what is known from the record of the rocks.

There we read that prior to the completion of the Continents there were immeasurable periods of ancient life forms, the strange old shapes of the Paleozoic Age, the less strange of the Mesozoic, and the more modern of the Cenozoic.

Vegetation, commencing with the lowest and simplest organization, the Algæ, advanced in the Devonian to a flora which presented, with Lycopodiums, Ferns, and Equisetæ, various cone-bearing plants, representing the large but inferior class styled from their naked seeds Gymnosperms. In the Carboniferous period came a rank and abundant growth, whose remains have given us

our stores of coal. Here, in addition, was found yet another great order, the Cycads, also belonging to the Gymnosperms.

As yet there were no Grasses, no Palms, no Angiosperms, the last and highest development. What is an Angiosperm? It is an Exogenous plant whose seed is covered, as the apple, rose, plum, etc., a plant whose seed is *inside* of the fruit.

Mesozoic plant-life, till far down and into the Cretaceous, presents the same characteristics.

There was an abundant flora, but no Palms, no Angiosperms, and most probably no Grasses. In the Cretaceous, the chalk period, suddenly and abruptly, vegetation begins to assume a more modern character. Grasses, Palms, and Angiosperms begin to appear, not dominant, but a promise of the future, "for this was properly the closing part of the era of the Cycads." *

In the Cenozoic there was an increase of those higher orders until they attained their present preponderance in the Tertiary. Here are found Plums, Almonds, Roses, Acacias, Whortleberries, Palms, Grasses, etc.

Hence, as to vegetable life, the culmination was attained in the Tertiary, since no higher development has since been made; there is no higher type than Palms and Angiosperms.

Is it possible to find a definition that shall include these heads of the great divisions, the exo-

* Dana, Manual, 1874, p. 471.

genous and the endogenous? I can think of none more perfect than, "the tree yielding fruit whose seed is in itself." *

This evidently is the kind of vegetation of which Moses wrote, "And the earth brought forth grass, the herb yielding seed, and the tree yielding fruit the seed of which is in itself." As in these the vegetable world culminated, the Author pronounces them "good," i. e. fitted for the sustentation of Man and the Class of animals most affecting his interests.

It is hardly possible to read thoughtfully this account and not wonder why two such diverse and yet so important acts as the appearing of the dry land and the completion of vegetable development, should be included in one epoch.

* "Tree yielding fruit whose seed is in it."

Dana (p. 768) considers this the philosophical characteristic of vegetation distinguishing it from inorganic substances. This is true without doubt, but no more true for vegetation than for animal life. Nor does that idea add anything to the force of "grasses, herbs and fruit trees." But if, by "tree yielding fruit the seed of which is in it," is meant what it plainly says, that the seed of these trees was covered, i. e. was inside of the fruit, thus distinguishing them not only from the cotemporaneous herbs yielding seed as well as from the inferior but preëxistent orders whose seed was not in the fruit but naked, then there is shown a deep and broad undercurrent of knowledge, that on the one hand takes in the Geological ante-human periods, their beginnings and culminations, and on the other, the profound analysis of Modern Botanical Science, which has told us of the structural and useful peculiarities of the great modern division of the Angiosperms.

If the purpose of dividing the narrative into just six epochs made it necessary to crowd two events into one division, it would seem every way more natural to place together the deposition of the waters and the appearance of the dry land.

The discoveries of Geology already discussed, give an answer which if it stood alone would attest the Divine origin of this Account. From them we learn, not only that the completion of the continents, i. e. the time of receiving the Divine approbation as "good," was an immeasurable distance subsequent to the deposition of the waters, the two being almost at the extremes of Geologic record, but that vegetable life which began soon after the beginning of the emergence of the continents, was developed along with them, and *both* reached their culmination in the SAME Geologic Epoch, in the Pliocene, the close of the Tertiary!

How little called for has been the fear of this most faithful Witness.

Another very reasonable inquiry is, why does the writer speak of "grasses, herbs, and fruit trees" and remain silent as to the previous and much more extended domain of Algæ, Ferns, Cycads, etc.?

Three answers suggest themselves.

First, because the vegetable world culminated in these. Second, because they are most useful for man and cattle. The third reason, not apparent upon the face of the narrative, but perhaps,

in reference to God's purpose of authenticating a Revelation, of far greater weight in his mind, was because this vegetation marks the close of the ancient type of climate which was distinguished for its monotonous uniformity.* It thus established a BIOLOGICAL DATE, subsequent to which began the modern type of climate characterized by changing seasons, and consequently, unequal days and nights.

Till well down to this time of "fruit trees" the Geological record assures us that the same plants and animals flourished luxuriantly from well toward the equator to latitude 78° at least. And as light is one of the most vital needs of plants, we are compelled to believe, if there be any truth in the doctrine of Uniformity of Law, that a somewhat equal arrangement of light and darkness prevailed at that time in the higher and lower latitudes, and that therefore the polar regions could not have then had days of six months duration, alternating with nights of equal length.

If this be so, then as a necessary consequence there could not have been the present alternation of seasons, and the cause of this alternation did

* Dana, Manual (1874) p. 352. "The temperature of the Arctic Zone differed but little from that of Europe and America. Through the whole hemisphere—we might say world —there was a genial atmosphere" (Close of the Carboniferous Age) "for one uniform type of vegetation and genial waters for Corals and Brachiopods."

not then exist. Ergo, the axis of the earth did not then have its present inclination, but must have been nearly perpendicular to its orbit.

After "fruit trees" came, according to the record of the rocks, the Glacial Epoch, and at the earliest subsequent period of which anything is known, are found days and nights of unequal length and changing seasons. Hence during that epoch the axis of the earth must have attained its present inclination of $23\frac{1}{2}°$.*

Such a change of obliquity, causing seasons and unequal days and nights, and affording a simple and natural measurement of the year, and signs for the arrangement of the Jewish religious festivals, exactly harmonizes with the Mosaic Account.

"And God said, Let the lights in the firmament (open space) of heaven, be to divide the day from the night," [the margin says "to divide between the day and between the night, i. e. to divide the time between them, giving to each its due but ever-varying share,"] "and let them be for signs and for seasons and for days and for years." †

* For a full discussion of this subject see Part III.

† Verse 14. The Common Version reads, "Let there be lights in the firmament of heaven to divide the day from the night, and let them be for signs and for seasons, and for days and for years."

The word "there" does not occur in the original, and the verb "let be" is the same in both places, save that it is of

How appropriate a description of such an axial change.

Note, too, the phraseology. It is carefully chosen, and is as remarkable for what it does not say, as for what it says. It is marvelously in accord with the thought that its Author knew that an increase of the inclination of the earth's axis then occurred, and was familiar with its effects. This, as Astronomers tell us, causes the Sun to divide the time unequally between the day and the

the singular number in the first. If so translated, giving it the same meaning in both, the translation would read, "And God said, Let it be that the lights in the firmament of heaven divide" . . . "and let them be for signs and for seasons, for days and for years."

This would imply their previous existence and simply denote their appointment to certain duties. It seems to me that one with a knowledge of all the facts of our Solar System (which God most certainly possessed) and with no previous theory to sustain, would so render it.

The Common Version implies the non-existence of these bodies, or at least their non-appearance, in the expression "let there be lights" . . . while the second expression, "Let them be for signs," etc., denotes simple appointment. I can see no good reason for the distinction.

As to the use or omission of the article, no argument can justly be drawn from its presence or absence, since it is only partially the equivalent of our own, and the translators have added it or omitted it in this very Chapter, as from their stand-point seemed to them best, and that, too, without any notice to the reader by italics or otherwise.

This change in the mode of translating the same word, is another instance of supposed science affecting the minds of the translators. As the Seventy thought to bring out more

night, and the moon to divide its hours of shining, giving the winter nights a greater share than would otherwise be possible. It also, in connection with the Moon, gave the "signs" indicating the time for the Jewish festivals, since the Passover fell on the first full Moon of *Spring*. It gives seasons too, and so makes it easy to measure the years; but of *months*, a far more obvious division of time, the account does not speak.

They alone, although so evidently dependent

clearly what they deemed an inspired Cosmogony ought to say, by translating the Hebrew word for expanse by *στερέωμα*, something solid, so they rendered "let be," in the first part of the verse by *γενηθήτωσαν*, "*let there be* lights," i. e. "let them come into existence," and in the second place by "*ἔστωσαν*," *let them be* "for signs," etc. The English translators followed in their footsteps and intensified the creative idea, for *γενηθήτωσαν* may also mean merely appointment, while our version drops that idea altogether.

One other verbal remark is not inappropriate. "And" is used simply as a connective, without necessarily indicating that the event mentioned in the following clause was subsequent in the order of time to that spoken of before. Instances in proof are not uncommon, but we need not go elsewhere to find them. In the account of this "day," is a case exactly to the point. After appointing the Sun and Moon to their respective offices, the writer adds, "and it was so." That is, the thing was done. The Sun and Moon, in obedience to the divine command, had already begun to rule the day and the night. He then goes on to say, "And God made two great lights," etc.

It is simply impossible that the writer intended us to understand that God made these lights *after* they had already obeyed his commands.

upon the "lesser light," and next to days the most natural to speak of, are not mentioned! Why? Because months (originally from new moon to new moon) are measured by lunar revolutions, and are unaffected by any change in the obliquity of the earth's axis. Nor for the same reason is any mention made of weeks, although their institution is one of the most apparent objects of the writer throughout the narrative, and stands out prominently in his subsequent writings.

It may be said that if my explanation be true, then the entire effect was produced upon the earth itself, while Genesis says it was something done to, or by, the Sun and Moon.

But this, it appears to me, is more than the words of the Author permit. He does not say, nor as it seems to me, necessarily imply, that anything at all was done to the Sun and Moon; nor, on the other hand, was it within his purpose to tell us the physical fact that nothing was done to them. True to its purpose of photographing facts, the Narrative simply announces God's intention or command that these luminaries should divide the time between the day and the night, and should be for signs and seasons, for days and for years, and tells us that the command was obeyed. That is all. It gives no word as to the physical cause.

Nor is this any proof of the Author's ignorance or untruthfulness. As well complain of the expected photographs of the Transit of Venus be-

cause all that will be obvious to the observer is a small black spot, and the great disk of the Sun. Its value will be in proportion to the truthfulness with which those two things shall be represented.

The great fact is that the Sun and Moon did divide between the day and the night, and were for signs and for seasons, for days and years, and that this event occurred after the production of grasses, herbs, and fruit trees, and before living species of animals. So much is said positively, and it is clearly implied in its silence as to months, that nothing was done to the moon. These answer all the conditions of the Narrative, and are in themselves physical facts of the highest importance.

Here I meet another class of objectors, who tell me my argument proves too much, if it proves the third period preceded the Glaciers, for such a climatic change as is implied in varying seasons and unequal days and nights, would necessitate many new species of plants and even of "grasses, herbs, and fruit trees," for the new conditions; and moreover that the fossils do show such, while Moses says the Creation of plants ceased on the "third day," and, therefore, here is a contradiction.

Upon a most careful examination of the entire account in both Chapters, I cannot find any assertion that no plants were created subsequently to this period. The writer does affirm that the

earth did then "bring forth grasses, herbs, and fruit trees." That is all. God may, or may not, have created plants of any kind, on some one or on each of the subsequent periods. The Narrative gives no intimation in the first Chapter. But it is pretty clearly intimated, if not expressly stated, in the ninth verse of the next Chapter, that God did create "trees" on the last creative epoch. Moreover, there is nowhere any assertion of rest from creative labor until the seventh day.

The attentive, thoughtful reader will here note how, in this case as in many others, difficulties vanish in proportion as we keep close to the sharp photographic character of the narrative, viz. that it *means exactly what it says, no more, no less.*

Placed as this fourth period is, after grasses, herbs, and fruit trees, and before the creation of living species of fish, and other water creatures, and fowl, it establishes the Biological date of the great Climatic change precisely where Geology places a great climatic change, i. e. at the era of the Glaciers.

After stating the offices of "the lights in the firmament," the writer, with emphatic repetition, guards against the possibility of the Star-worshippers saying that his Creatorship did not include the Stars; he amplifies and repeats; He made the sun; He made the moon; He set them in the heavens to rule over the day and over the night; He made the stars also.

That I am correct in considering the sixteenth verse as retrospective, is clearly shown, apart from any verbal or grammatical argument, by its including the "stars also." As the Stars must have been intended, as well as the Sun and Moon, in the first verse (otherwise it means nothing), the subsequent statement must be merely a repetition.

It would be too illogical to say that in this statement, where "lights" and "stars" are the object of the *same verb*, creation was intended in the one case and something very different in the other. It cannot be that a writer able to pen sentences that have ever been the admiration of critics, should so far stultify himself as to say in the first verse, that God created the heavens and the earth, and then in the sixteenth verse, say that he did this very thing on the fourth period after.

In these words, "the stars also," I note a careful guarding against misapprehension, a fact thrown in that refuses to harmonize with any explanation save one based on the actual facts of the history of the Universe.

Moreover, in this clause, "the stars also," there is a reaching out to truth which has just been scientifically demonstrated, viz. that the stars have the same origin as our earth and sun. It has been, for not many years, strongly suspected that this was true, for the elliptic orbits of the double stars show that they are subject to the

same laws of gravitation, inertia, and motion; while their light is obedient to the same optical laws. But it was reserved for that most delicate of all means of investigation, that marvel of power, the spectroscope, to tell us that the materials of those distant orbs, as well as of our own sun, are essentially identical with those of the earth on which we live.

"God made two great lights." Here I note, before leaving this part of the account, a precision of language that our English does not express. In verses 3, 4, 5, the word light differs in more than grammatical number from the "lights" of verses 14, 15, 16. These indicate bodies not composed of light, but places or sources whence light emanates.

The events of this period not only gave mankind the pleasures arising from changing seasons, but also largely increased the limits of the earth's inhabitability. It was not a stage to further progress in this direction, but marked the completion of climatic preparation for the coming man. It might be warmer or colder, but henceforth the long winter nights were to be followed by the long days of summer. The monotony of the preglacial climate was gone forever. Those changes necessary for this purpose having been completed, the arrangements of day and night, and seasons, bore the Divine inspection and were pronounced "good," i. e. not only "good" as a

source of enjoyment to man, but completed. No further change in that direction has *since occurred.*

All investigation confirms the verdict.

Geologists tell us that after the work of the great circumpolar upheavals was ended, and the epoch of the Glaciers drew toward its close, summer revisited the earth. The melting ice flooded the world with ice-cold water to an extent of which we can with difficulty conceive. Immense lakes and rivers covered a large portion of its surface. The ocean and the land, the lakes and the rivers, must, in temperature, have been for a long time in much the same condition as present circumpolar regions, such as the upper part of British America, or the northern parts of the Eastern Continent. The conditions of animal life of that period and of these regions now, must have been in a great degree identical.

The fauna at this day characteristic of circumpolar lands and waters, are fishes and fowl, whales, and other sea monsters living in, or on, the water, and the tiny mollusks such as form the food of the right whale. These all swarm in an abundance, of which those who live in warmer climes can form no conception. Nowhere else do water animals and water fowl so abound.

Such by "Uniformity of Law," and, if you please, by "Natural Selection," should have been the character of the animals that followed the

work of the fourth day, if that was the era of the Glaciers.*

Compare with this the Mosaic record of the work of the fifth period. "God said, 'Let the *waters* bring forth *abundantly* the moving creature that hath life, and fowl that may fly above the earth in the open firmament (expanse) of heaven.' And God created great whales,† and every living creature that moveth which the waters brought forth *abundantly*, after their kind (i. e. water creatures), and every winged fowl after his kind."

The language is general enough to include all living species of water animals and fowls; but it is marvelously characteristic of the present fauna of circumpolar regions, and, if so intended, fixes, on this side, the Biological epoch of the grand climatic change of which the Glacial was the scene.

Here I may be met with the fact that although "fishes, reptiles, birds, and mammals" of the preglacial period are now utterly extinct, yet undoubtedly some protozoans and mollusks have survived. Whether such a survivorship of so small a number

* Lyell, Principles of Geology, p. 125, 126, says, speaking of a period preceding man: "It appears that an arctic fauna specifically resembling that of the present seas, extended farther to the South than now. The date appears to coincide very nearly with the era of the dispersion of erratic blocks over Europe and North America," i. e. the close of the Glacial Epoch.

† So rendered in our version, but rather any large creature living in the water, not properly a fish.

of species, so low in the scale of existence, would affect the literal truth of so brief a statement, is a question that I think might justly be answered in the negative. But this objection, minute as it is, disappears on a close examination of the verses themselves.

In the twentieth verse is an exact statement of what God proposed to do, or to have the waters do. It was simply to bring forth abundantly the moving creature that hath life (i. e. living, moving creatures, as fishes and other animals) "and fowl." That is all. If they brought forth abundantly such a fauna, the account is literally verified. There may already have been many creatures in the seas, or there may have been few; the account does not say. After stating God's purpose at that time, the Author, with the view of asserting God's universal creatorship, says, "God created great whales and *every* winged fowl." Each verse is literally true. Each subserves its own purpose. The thought that underlies the statements is the same as that discussed in reference to the repetition of God's creatorship, as to Sun, Moon, and Stars, and it again appears in verses 24 and 25, in the account of the work of the next period.

The waters it is evident were fit for life sooner than the land, save the smaller islands and the shores of other lands. Inland, a lower temperature prevailed. Floods and torrents laid waste the country. During the earlier portion of this

transition period, the possibilities of animal life, other than that mentioned, must have been small. But as the ice disappeared, the conditions grew more and more favorable, until at last the land was ready for its proper fauna. The gigantic mammalia of the Post-Tertiary made their appearance, flourished, and began to pass away, and toward its close began to be found the remains of the *living* creatures of to-day, "cattle, beasts, and creeping things."

These are the animals of which Genesis speaks. "And God said, Let the earth bring forth the *living* creature after his kind, and cattle and creeping thing, and beast of the earth, after his kind; and it was so."

Is not this justly and fairly a description of the "living" fauna of to-day, given by one to whom man and his interests are objects of central importance?

This work, then, as complete and satisfactory to the Divine Architect, received his seal of approbation, and he pronounces it "good."

The study of ancient and modern organic life has developed three great facts:

That all organisms were outlined in the first created of each grand division, i. e. the first mollusk exhibited the general plan of all mollusks, the first radiate, of all radiates, and so on.

That along the course of each series, there appeared from time to time "comprehensive types"

which, with the characteristics of the group to which they belong, exhibit others of groups not yet in existence, prophetic of future developments.

That those characteristics which united give what naturalists call species, are ineffaceable, at least in historic times.

I note after the Mosaic Account of each organic creation thus far, the words "after his kind." Is not this the true formula that embraces these three ideas?

Last of all in the records of the rocks, we find the remains of man.* His bones are sometimes mingled with those of gigantic mammalia then living, but extinct before the historic period commenced.

We find no prototype of him, no evidence of beings similarly endowed. Whatever remains are found belonging to Man, belong to him alone, and to no intermediate creature. He stands on an eminence unapproachable.

Genesis tells us, "So God created man in his own image."

This was the culmination of God's creation, and then, as it were closing up his work, with the arrangement of the Garden, the naming of the animals, the formation of Eve, the bestowal of his blessing upon the pair, the grant of dominion over

* Lyell, Manual, p. 117. "That portion of the Post-pliocene group which belongs to the human epoch, forms a very unimportant feature of the Geological structure of the earth's crust."

all other creatures, the allotment of seed-bearing herbs and fruit-bearing trees to man for food, and the green herb to all others, "God saw every thing that he had made, and behold it was all very good."

Is it not so?

The wisest of philosophers measure their acquirements by their knowledge of this that God has done, and find the greater the height to which they attain, the more boundless appears the vista beyond.

After man, Geology tells of no new creatures. That power which produced such a marvelously abundant succession of species, has, since man's appearance upon the globe, ceased to operate.* Science seeks in vain for an explanation of this strange cessation.

But in Genesis is found a key to the mystery. After God had through six creative periods brought his world to a condition worthy, in his infinite judgment, of the verdict "very good," given on the sixth and last of the "days," we are told, "On the seventh day God ended his work which he had made, and he rested on the seventh day from all his work which he had made."

We have now gone item by item through the Mosaic Account of Creation. It touches modern

* Darwinians deny this, but base their denial upon the assumption that somehow and somewhere proof to the contrary will yet be found. An uncertain foundation on which to rest so large a conclusion!

Science in almost every phrase. Throughout it all, there is no hesitation, no doubt, no cloudiness shrouding ignorance in words that mean anything or nothing, but the simplest and most positive assertions, the confident utterance of one who, in the fulness of perfect knowledge, describes actual occurrences.

The identity of this Narrative and the latest results of Scientific investigation, made too often in no friendly spirit, is so complete that they stand or fall together, a fact that is absolutely incomprehensible on the theory that the former is the production, not of Moses merely, but of the united wisdom of all the world down to within the last quarter of a century.

Nor does it aid in solving the mystery to assume that Moses obtained the story from tradition or more ancient documents. It is only thrown farther back, and the question still presents itself, "How did any *man* obtain this knowledge?"

To this question I can see but one answer. He who formed the world for man gave him this history.

I submit whether those who reject this explanation are not bound to give one which shall be more satisfactory?

CHAPTER III.

THE "DAYS."

I NOW resume the consideration of the "day" mentioned in the Mosaic Cosmogony.

The view most prevalent among Scientists who accept this Narrative as of Divine origin, is that the "Days" spoken of, are simply indefinite periods. Much can be said in favor of this opinion. It has moreover the advantage (if it be one) of being no newfangled notion, for some of the most profound writers, centuries ago, held that these "days" embraced a larger meaning than the time of a diurnal revolution, and this from a consideration of the text itself, and not from any special knowledge of the physical facts involved.

The question from this stand-point is ably argued by Dr. Tayler Lewis, in his article on the "Six Days," in Lange's Commentary.

To this view I cordially assented, until within a brief period. But reflection upon the curious and careful wording of each phrase, brought the conviction that the force of "day" is not exhausted by saying it refers to periods of indefinite length, although that meaning is most clearly indicated in the fourth verse of the next chapter.

I became dissatisfied with any explanation that ignores the intense literalism of the whole account.

With a view to harmonize all the conditions of the problem, I carefully reëxamined the narrative, and applied the key that unlocked so many difficulties in the other parts of the story, viz.:

"The Author meant just exactly what is written, no more, no less."

As to the interval of time between any two events successively mentioned, we have no data, in the account, by which we can judge of its extent, and can no more form an idea of it, than of the true distances of the stars from each other, by their apparent places in the sky.

The first use of this word occurs in verse 4, "And God called the light day." Here evidently "day" is simply the opposite of night, a period of about twelve hours.

This is the primary and most common meaning of the word. Another and higher idea is found in the use of day as embracing a period of light and one of darkness, or one evening and one morning. This is the second use. The writer says, "And the evening and the morning were one day." These evidently make the limits of one diurnal revolution, or twenty-four hours.

We would naturally expect Moses to say, as our English translators have made him, "were the *first* day." But in the avoidance of the latter

expression, I see another indication of the boundless knowledge of the Author that lets nothing escape him.

Moses, writing from his own knowledge, had that been possible, would naturally have placed the formula, "the evening and the morning were the first day," directly after God pronounced the light good. This first announcement of completion and perfection was properly the "first day," according to the analogy of the "days" in the other parts of the chapter.

Moses could not have known what, thanks to Laplace and others, is now so evident, that such a statement could not have been the representation of a physical truth, for when light appeared, and in its perfection merited and received the Divine commendation as "good," and for a long, long time afterward, the earth was an integral portion of the great Cosmic Nebula. Not even the outermost planet had yet left the parent mass. Hence a day at that time was physically impossible.

When, therefore, the earth had an individual existence, and by its axial revolution began to measure duration by days, the time for saying the *first day*, according to the analogy of the other days, had long been passed.

The creation of matter, the imparting of motion and the consequent giving forth of light, were events that wholly antedated the individual existence of our earth, and would have been equally

real occurrences if the Cosmic Nebula had not yet changed to planets and Sun.

But this separation of the light from the darkness was a fact specially pertaining to the earth, and is the beginning of its individual history.

Hence, in order to bring this important epoch into the "six days," the Author saw fit to open the narrative with the assertion that this evening and morning of separation were simply "one day." *

Another epoch of world-growth commenced; ages upon ages was the hot dull ball cooling, ever bringing nearer the day when the waters could lie undisturbed upon its surface, or float in the upper air. At last it came. The evening and the morning when God had completed this great work, "and it was so," was the second day of work ended.

Another period begins; vast progress is made; the dry land appears; the waters are gathered into seas. Grasses, herbs, and fruit trees mark the culmination. God contemplates his work, and that day when "God saw it was good," that

* In the peculiar wording of this and the succeeding enumeration of the "days," is another welling forth of the infinite knowledge of the One who indited this account. Knowing all things, speaking absolute truth, his words have a fulness of meaning that will ever expand with the growth of our knowledge. Not to interrupt this article I have thrown together, in a separate section, some of the thoughts suggested by the peculiar wording of which I have spoken.

day of announcement and satisfaction, was the third day.

A fourth epoch opens; great climatic changes occur; the Sun and Moon, henceforth, are to be for signs and for seasons, for days and for years. Whatever may have been the physical changes that took place, there came a day at last when they were completed. The work was accepted and pronounced "good," and that day, the end of this epoch, the day of approval, was the fourth day.

Another epoch begins. Animal life, which commenced untold ages back in the Protozoans, Mollusks, Radiates, and Articulates of the Paleozoic Period, and which had passed through so many stages of progress, found its first culmination in living species of fowls and fishes. "God saw that it was good," and this day of approval and announcement was marked in the sacred record as "the fifth day."

Another period opens. Modern "beasts and cattle" walk the land. Man, the master of all, appears. The day of entire completion came, the day when God looked upon his work and pronounced it "very good;" this day was the sixth day.

In these verses, from the eighth to the last, the writer has given a third use of the word, an epochal day, a day of announcement, a day of completion, having no reference whatever to the length of the day, as when I speak of Independ-

ence Day, the term has no allusion to the length of that day.

Again, in the fourth verse of the next Chapter there occurs yet another use of the word, and this the more interesting because it is the only phrase in either Chapter, that purports to tell us how long was the time in which God created the earth and the heavens.

"In the day the LORD God created the earth and the heavens." This day cannot possibly be twenty-four hours, for the writer has told us of six epochal days that certainly elapsed during the time of creation; there is no logical escape from the conclusion, "the day" of the second chapter must be a period of indefinite duration, as when an old man speaks of things that happened in his day.

A day came when God ceased to work, and the day of that cessation was the seventh of this epochal series.

By thus combining the meanings of the word day, meanings certainly not incongruous to the context, and in themselves of every-day use, we are able to satisfy all the conditions of the problem; the literal six days, the indefinite period, and the Geological epochs, all blending like the colors of the spectrum into one beam of light.

I cannot feel that I have done full justice to this question of the "days," in its broadest meaning, without considering the assertion made in the

Fourth Commandment; but as I have set out to examine the Story of Creation recorded in Genesis, as an independent document, I shall not undertake the consideration of the other at present. In Part II. the subject will be resumed.

ON THE PECULIAR PHRASEOLOGY OF THE "DAY" CLAUSES.

When reading thoughtfully the Mosaic Account of Creation, one cannot avoid being impressed by the sixfold repetition of certain expressions which, for lack of other name, I have styled the "day clauses." If he extends his examination into the Septuagint, he finds in these certain peculiarities that do not appear in the English Bible, and on referring to the Hebrew he finds there the same.

Believing, as I am forced to do, from the results of the examination of this Narrative thus far, that every word and phrase in it, was chosen for a purpose, and that the harmony between Science and this Account increases in proportion as we get closer to the very words of the Author, I propose now to study these declarations in order to discover, if possible, their counterparts in our world's development.

We read, verse 4, "And God divided between the light and the darkness (v. 5), And God called the light Day and the darkness he called Night, and the evening was . . . and the morning was one day." This is the reading of the Septuagint

and of the Hebrew, while our English version drops one of the verbs, makes the other plural, and for "one" substitutes "first." As the Hebrew is the only account that has any claim to be inspired, I dismiss the others without further remark.

The use of the cardinal "one," and the repetition of the verb with one predicate nominative, the other being easily supplied, are forms of expression so peculiar in themselves that I cannot avoid the belief that they were employed in view of some physical fact well known to the Author, and by him deemed sufficiently important to be thus noticed.

I am aware that the Hebrew ordinals do not extend below "second," and that the numeral "one" is sometimes used when the context clearly indicates that it must be translated by "first," but such use is comparatively rare, and occurs only where no ambiguity can arise. In other cases a different word meaning "head" is employed, particularly if it is specially intended to denote the first of a series or procession, as in the English Version.

That I am justified in not considering this as merely another mode of saying "first," is shown not only by the Septuagint, as I have already said, and by the Vulgate, but Josephus speaks of the phrase "one day," and calls attention to it as something needing explanation.

To get at the full meaning of these most pecu-

liar expressions, one must place himself, as far as possible, on the stand-point of the Author, and turn upon them all the light that Science has given us as to the condition, form, inclination and movements of the world from "the beginning" to the present moment. This in all humility—for our highest knowledge is ignorance in comparison with his.

The Author of Genesis knew, with the clearness of actual vision, the diurnal motion of the earth, its sphericity and the position of its axis. If the latter was at that epoch (i. e. when the earth became non-luminous and day and night properly began) perpendicular to the plane of its orbit, as I hope to show hereafter, the crucial phenomenon indicating such a condition would be the equality of the days and nights. Not only was that *a* crucial phenomenon, but it was the only one then possible, since the intense heat of the scarcely solidified earth as yet forbade all thought of alternating seasons.

This condition, if it existed, was one of immense importance as a stage in the development of our globe, one whose influence must have been felt in modifying all its subsequent progress. To describe it in scientific formulæ was simply impossible; there remained only one course, viz. to put upon record a physical fact, which characterized it. The only physical fact of the kind required,

which it was possible to put into words, was the equality of the day and night.*

Note the manner in which this is done. That we may not mistake "day" for the period of an entire axial revolution, but may limit it to the special meaning which the Author intends to employ, he first defines it as the period of light in opposition to that of darkness. "The light he called Day, and the darkness he called Night." How better express that thought? How more clearly define his use of the words? Then, having thus limited the "Day," he adds, the evening (i. e. from sundown forward) was—what? Evidently the sole substantive "day" must be the thing which "the evening was." In like manner he says, "and the morning was one day."

Hence, by the familiar axiom, "things equal to the same things are equal to each other," the evening was equal to the morning. In other words, the time from sundown forward to the coming light was equal to the time from sunrise to the coming darkness, or in more modern phrase, the day and night were equal.

In so brief and pregnant a narrative it may well be that one meaning does not exhaust it. That there is here also a reference to the order of succession, is evident, since the next is styled the

* The reader is referred to Part III. for the full argument. I now assume that it is a fact that at this epoch the earth's axis was nearly perpendicular to its orbit.

"second day." This idea was the only one which the Jews derived from the text. But this is no proof that the Author so intended to limit himself. That their understanding was no measure of the wealth of meaning conveyed, is shown by their distorted views of the statements relative to our Saviour.

The only key to this account is, that the Author, knowing all now known to Philosophers, and infinitely more, and striving to compress into a few phenomenal sentences some fragments of his own infinite knowledge, has given us more than we shall ever comprehend.

Thus much as to the "one day." As to the following days, the wording is equally peculiar. In them we find *only* the ordinal numbers, showing it to be preëminently a matter of numerical succession, but it is accompanied by that strange repetition of the singular verb. Our language finds it difficult to indicate this change of meaning without a greater change in the form of expression than is found in either the Hebrew or the Greek. As literally as I can render these phrases they read: "'Twas evening and 'twas morning the second day," "'Twas evening and 'twas morning the third day," and in like manner through the six.*

* The phrase for the sixth day seems to be rendered more emphatic by the use of the article. I know of no reason for this, except, perhaps, its culminating character.

What does that mean? The expression occurs nowhere else. Is the repetition of the verb mere surplusage? I cannot think so.

If one, in the study of Laplace's great work, met some unusual form of expression, but often repeated by him, it would be presumption in him to reject the great master's words as surplusage because to him they seemed to convey no special meaning. It would rather be the part of modest common sense to say, the Great Geometer has shown by his profound analysis that he is master of his subject, and the very peculiarity and frequency of this baffling phrase indicate a purpose in its use. There must lie hidden a sense which I have not yet been able to reach. The fault is in my ignorance, or in my lack of mathematical acumen.

If, then, the peculiar phraseology be not surplusage, there is something beneath the surface for which I propose to search.

First, then, I note that the "one day" did not follow an announcement of completion, but merely a statement that God divided between the *light* and the *darkness*, and is, as I have endeavored to show, simply the statement of a physical fact, the then equality of the days and nights.

Secondly, I also notice that each of the other "day clauses" follows an announcement of completion.

There is, apparently, somewhat of variation from this statement in the third and sixth days.

On each of these there are two announcements of completion, but those on the third day were really synchronous, as Geology shows, while on the sixth, I am almost sure there was the same synchronism; but, however that may be, the "day clause" follows the final and preëminent verdict of completion and approval, being not the completion of any one part but of the totality.

The utterance of such a verdict, "it was so," or "God saw it was good," was the work of but a moment, yet it marked the completion of an infinitely important stage of world-growth. It was not a completion limited to any one locality, but it affected every part of the globe, in harmony with the Geologic belief that each great era of structural change or development of organic life was world-wide in extent.* Read in this light, these phrases become intelligible. They are announcements made for no limited portion of the globe, but *include*, in *modern terminology*, both hemispheres. In the universal language of phenomena, they embrace the places where 'twas evening as well as those where 'twas morning, from where the sun was setting to where it was rising, and from where it was rising to where it was setting. No other phenomenal language can better express this modern idea of world-wide

* The grander subdivisions or ages in Geological history, based in organic progress . . . are universal ideas for the globe. (Dana, Manual, p. 138.)

simultaneous completion. By giving the number of each day, the Author also keeps prominent his purpose of instituting six days of labor and one of rest.

Even man's creation is first given, not so much as a local event, as in connection with its being the completion of the entire work, and the "day clause" follows the earth-wide assertion "and God saw everything that he had made, and behold it was all very good."

In speaking of the seventh day there is a marked change of expression. We do not read 'twas *morning* and 'twas *evening* the seventh day, but "God rested the seventh day."

This has elicited various explanations, none of which appear to me satisfactory. Read, however, in the light of the other statements, the difficulty vanishes.

We have seen that the announcements of the other days were announcements of completion world-wide as to the extent of country referred to, while from the nature of the act, only momentary as to the time occupied, and that at the instant of their utterance, literally 'twas evening upon one side of the globe and 'twas morning upon the other, whatever may have been the day, whether the second, or third, or sixth, or any other. But this seventh day had special reference to man, and to man only, and it was not an announcement merely, but a statement of a fact

that God rested from his work a day, a complete diurnal revolution of the earth. Hence the length of the rest was indicated: it was twenty-four hours.

Did, then, God resume his work on the next day?

Moses does not inform us, but I may add from another source, to me of equal authority, that God's work is yet going on. "My Father worketh hitherto and I work."

Has he, then, since that day, created new species? The written Record gives no answer.

Other questions press upon me, that I would most gladly answer, but I have reached a limit beyond which I can only gaze.

CHAPTER IV.

THE EVIDENCE FURTHER CONSIDERED

AMONG the scientific acquisitions bearing testimony to the truth of the Mosaic Narrative, I have mentioned *a* Law of Development.

The existence of such "a mode of action" is so clearly indicated in Genesis, and at the same time is in such marked opposition to the belief of all the world until a quite recent period, that it is well worth thoughtful consideration.

By this Law of Development, I understand that matter passes from a lower to a higher state of utility or beauty, not by one vast bound, as in Eastern stories palaces are reared by magic, but by a longer or shorter series of progressive acts, often too close to be observed, although at other times easily distinguished. Such development may occur under the influence of law apart from intelligence, as when the atoms in a solution arrange themselves in certain fixed lines or axes to form crystals. Or it may occur under the guidance of intelligence, as when a chemist separates silver from argentiferous lead by crystallizing the baser metal; or in a higher and more complete form, as when the western pioneer develops the

virgin forest into farms and cities. The last is the species of Development to which the Mosaic Account of Creation points, differing, however, in degree as the Actor in the latter differs from the western pioneer.

It does not properly come within the limits of this discussion to draw the line between *this* law of Development and that protean something known as Evolution. Indeed it is very difficult to find any definition that covers the whole subject, each writer having his own. If I might venture to add my quota, I would say, Development is progress under control of intelligence, and Evolution is progress under the action of forces with, or without, intelligence. Others use these words as synonymous.

"Evolution," at least in the hands of some, ignores all intelligence, and runs counter to that consciousness which to each man is, for him, the highest of all evidence. It denies all freedom of will, and obliterates all distinctions between right wrong.

But a Law of Development, as I have defined it, admits all the conditions of the problem of life. Subordinate to intelligence and will, it accords with what consciousness tells me of my own actions.

The Mosaic Cosmogony is a sublime illustration of this Law.

It represents the world at first without form

or solidity, void and dark; then, vivified by motion, it became self-luminous. To this succeeded a non-luminous or planetary condition with days and nights. A deposition of water marks a further advance.

The continents next "appear;" then a vegetation "of grasses, herbs, and fruit trees" marks the culmination of the vegetable kingdom in species most needed for the use of man. After this, occurs a climatic change from the monotonous uniformity of the ante-glacial period, to the pleasing vicissitudes of seasons, the varying length of days, and the long, bright moonlight of winter nights. Animal life then culminates in the fauna of to-day. Last and crown of all, man appears, with faculties capable of dominating all animate nature, and of making moral and intellectual progress as yet unlimited.

Here clearly is growth and progress, with a unity of plan that characterizes what in all other matters we style intelligence.

For this order and slow growth I can see no reason save in the will of the Great First Cause. Had such been his pleasure, I can see no good reason why our world had not been at once called into perfect existence.

I venture to believe in this controlling Intelligence, notwithstanding the high authority of Mr. Herbert Spencer, who assures us that the proposition that "an originating Mind is the Cause of

Evolution" can be entertained so long only as "no attempt is made to unite in thought its two terms in the alleged relation." * This test destroys at once all idea of an "originating Mind." It bids me believe that the cathedral at Milan is not the creation of the "originating mind" of the architect, but simply the work of undirected forces, a kind of crystallization, for I cannot, even "in a dim way, connect his successive states of consciousness" with that elaborate structure. I cannot "unite in thought" the titillations of the expanded end of the optic nerve, with the beauties of the landscape, nor the beating of aerial waves against the drum of my ear, with the enjoyment of hearing. Yet, unable as I am, "even in a dim way," "to unite the two terms in the alleged relation," I know it exists. Science acknowledges it, and rejects the proposed text.

Nor is there necessarily involved, in the idea of a personal God, the apparent absurdity which Mr. Spencer claims, to wit, that a "single series of states of consciousness causes the hundred thousand waves that are at this moment curling

* Compare this assertion of Mr. Spencer with the statements of another equally high authority in the same school. I refer to the statements already quoted from Prof. Tyndall's Address before the British Association.

As far as I can discover, it is the originating *Mind* that these gentlemen (or at least Mr. Spencer) object to. Call it an originating "Power" with Prof. Tyndall, or "Ultimate Power" with Mr. Spencer, and their objections vanish.

over on the shores of England." In a sense this is no absurdity.*

It cannot be denied that a pin machine is the product of "an originating mind." "A series of states of consciousness" was the cause of the original machine, and of all others like it, as well as of each movement resulting in the formation of one pin or a million. Yet we need not, and do not, conceive of the inventor as himself pointing and heading each one. Mind not only was the cause of the machine, but Mind sets it in motion in the morning, and stops it at night. During the hours of work, Mind is not apparent, save as we infer its action from the perfect adaptation of the whole to the end in view. Yet the eye of the

* Revelation tells us, "Not a sparrow falleth to the ground without your Father," and "Not one of them is forgotten before God," which Mr. Spencer would tell us is absurd. But he would see no absurdity, but a physical fact, in the assertion that every atom in the falling sparrow affects, not merely every atom in our earth, and the immense sun, and the more distant planets, but the remotest fixed star whose light, winged at its creation, still speeding on its way, has yet to reach our earth. Light, inconceivably swift, is laggard in comparison. Laplace tells us that if gravitation be not absolutely instantaneous, it speeds with a velocity at least 50,000,000 greater than that of light.

The light from the nearest fixed star requires three years to reach us. Over that inconceivable space, ere one's pulse had beaten twice, gravitation would carry the impulse of that sparrow's fall. This physical fact is inexpressibly the more difficult to believe.

The Christian Scientist receives both.

Master is upon every part, and the hand of intelligence is prompt to guide and control. Waste, damage, utter ruin would soon mark their absence.

In this Narrative, God is represented as building and setting in operation the machinery of our world. A series of Divine acts is recorded, and thenceforward "God rested from all his work which he had been making," and it moves on of itself, although the eye of the Master is ever upon it, and his hand ready for all needed interference.

The Mosaic view of God's part in the development of the Universe is this: He created matter and imparted motion, i. e. the forces producing motion. These forces are sometimes represented as working in obedience to command, as when God said, Let there be light. Sometimes he is represented as directly acting. Hence the Narrative speaks of God's creating; of things formed without cause assigned; of things formed by or out of matter in obedience to his word.

Thus in the first verse God creates; in the third, God commands the light to be; but in the fourth, God divides the light from the darkness; and in the seventh, again, God made the firmament. In the ninth verse, natural forces only are spoken of: God said, Let the dry land appear; so in the eleventh, he commands the earth to bring forth grasses, herbs, and fruit trees, and in

the next we are told, the earth brought them forth.*

In the fourteenth verse God commands such changes to occur as produced seasons and varying length of days; but in the sixteenth it is said, God made the heavenly bodies and appointed them to their several offices. Then in verses twenty and twenty-one, there is a crossing and recrossing of the thread. "God said, Let the waters bring forth," and, God created the animals which the waters brought forth.

A similar intermingling of the natural and the supernatural is found in verses 24 and 25. God said, Let the earth bring forth beasts and cattle, and then the account says, God made them. Again, in the following verses, God appears as the sole creator. "Let us make man," and "so God created man."

In this Narrative, Creation and Development meet. The two ideas are so interwoven that separation is impossible, without mutual destruction.

The following seems a correct analysis of the

* I follow the received version in the use of the formula. "Let there be,," 'Let the earth bring forth," etc., although the Hebrew has for this, properly, only the simple future tense. It is rather the announcement that something will or shall occur, than a command to the thing itself.

Such is the wonderful advantage of a purely phenomenal statement, that the Greek, Latin, and English translators have been unable to seriously warp the text.

ante-human history of our globe, as given by Moses, and read in the light of present knowledge.

It assumes as a truth that admits of no question, that the cause of all things is that Being whom we call God. Then follows the broad assertion, taking in the material universe, that God created the heavens and the earth. Immediately following is a characteristic description of the primordial condition of our earth as nebulous, i. e. cloudlike, "without form and void," and by a masterly stroke is revealed the fact that our earth was yet an integral portion of the Cosmic mass, for "darkness was upon the face of the deep," i. e. it was prior to the formation of light, which we now know occurred before the segregation of our world. It tells us that motion came from that same First Cause, was communicated to the inert mass, and that not till after motion did light appear.

Again, a master-stroke, and the statement that "God divided the light from the darkness," like a flash of lightning in a dark night, enables us to take our bearings, and we find the nebulous condition ended, the earth a solid, non-luminous body.

Once more the scene lights up, and the dashing waters below, the clouds above, and the open space between, tell us that the world has reached a temperature when life begins to be possible.

Next the Continents are upheaved, and the seas gathered into their appointed places.

Vegetable life, which began so early, culminated in grasses, herbs, and fruit trees, in the same epoch in which the Continents reached their full development, marking, too, the close of the ancient type of climate.

In the next epoch, whatever may have occurred, this much is certain, that the world came out of it with the modern type of climate, the intense heat of summer sharply contrasting with the cold of winter.

Following this climatic change was a fauna characterized by fowl and water creatures, which the waters brought forth abundantly.

Afterward, the land fauna culminated in "the beasts, cattle and creeping things" of species now living.

During this last epoch man appeared.

If this is a correct analysis of the statements recorded in Genesis, how, I would ask Prof. Tyndall, are "our ideas of the Universe and its Author improved by the abandonment of the Mosaic Account of Creation?"

Nay, in all seriousness I would ask, does not "the abandonment of the Mosaic Account of Creation" necessitate the abandonment of Science itself?

Surely the Nebular Hypothesis is utterly exploded, if the earth was never "without form and void."

The Correlation of Forces is only a beautiful

figment of the imagination, if Moses did not record a physical truth when he wrote that, prior to motion, "darkness was upon the face of the deep."

The Undulatory Theory of Light must fall with the Correlation of Forces, if it is not true, as Moses says, that light in order of time came after the impartation of motion.

The laws of heat, the expansion of water into vapor, the capacity of gases for moisture, as affected by temperature, all are a delusion, if the oceans were not once suspended above the earth in the atmosphere, and if it is not true, as Moses says, that there came a time when "an open space (firmament) divided the waters which were under it from the waters above it."

The record of Geology is a series of "beautiful myths and stories," if Genesis is romancing when it says the development of the continents was subsequent to the deposition of the waters.

Geography has egregiously blundered if Genesis is wrong when it asserts that the waters were gathered into "one place."

Physical Geography is unreliable if Moses errs when he wrote that the arrangement of the land and the water was "good."

Geology deserves to be classed with the effete Sciences found in the sacred books of the Hindus, if it be a physical falsehood that the completion of the emergence of the land occurred in the same epoch as the culmination of the vegetable

kingdom in Angiosperms and Palms, that is in "the tree yielding fruit whose seed is in itself."

"Uniformity of Law" is as baseless as Geology, if the uniform types of plants "luxuriantly flourishing" in all latitudes prior to the completion of the land and culmination of vegetation (toward the end of the Tertiary) do not indicate a climate differing exceedingly in the uniformity of light and heat from the climate of to-day.

Does, then, Moses err when he says that *after* that epoch the sun and moon were to be for signs and for *seasons*, for days and for years?

If so, then Geology has again proved its own unreliability, for it certainly has told us that in those earlier days there were "no zones of climate," and I think the evidence abundant that there were no zones of light. Certainly there were no seasons.

Geology tells of a period of intense cold, when ice covered the earth from the poles far down toward the equator, and that this followed the period of vegetable culmination. After the Climatic change Moses places a fauna of water creatures and fowl. If Moses errs here, then Uniformity of Law is an unsafe guide or the accounts of the Circumpolar fauna are false.

The record of Geology is not true if Moses errs when he places the development of *living* cattle and beasts, and many other creatures, subsequent to "grasses, herbs, and fruit trees,"

subsequent to the climatic change introducing seasons and "zones of climate," subsequent to the post-glacial water fauna.

Paleontology is not a true Witness if "living species of fish, reptile, bird, or mammal," were in existence before or during the epoch of grasses, herbs, and fruit trees, or before the epoch of climatic change.

Gravity and Optics, the one claiming through mathematical Astronomy to demonstrate the elliptic orbits of the Stars, the other, through the Spectroscope, professing to give us reliable information as to their constitution, have joined this conspiracy to deceive mankind; nay, the very elements have abetted the plot by wilfully giving spectrum-lines identical with those from the Stars, if it be false that the "Stars also" have the same origin as the Sun, Moon and Earth.

However much the reader may reject from what is here claimed to be the teachings of Science, enough will remain to justify the assertion that Astronomy, Geology, and every branch of knowledge bearing upon the origin, early condition, and order of development of our world, must be placed among "the myths and beautiful stories" of the past, if the statements recorded by Moses are false.

Science cannot reject this Narrative without committing SUICIDE.

COMPARISON OF THE TWO RECORDS.

To aid in comparing the two Records, I have placed in parallel columns the facts ascertained by Scientists and the statements made by Moses. In both are great blank intervals. Where these occur only in Genesis I have written under that column "silent," where they occur in both I have made no remark.

The harmony between the two becomes the more wonderful when we reflect that the men who made these discoveries were unconscious of their bearing upon the Bible account, and too often thought they were diligently and successfully laboring for its overthrow.

The history of the Earth may properly be divided into two grand Periods, the Cosmic and the Telluric. The former is equally applicable to all the systems in the Universe. The latter I have subdivided into two portions, of which the first is, in like manner, the history of all systems where planets have been evolved. The second is the development of our own world, and is applicable to no other planet.

THE COSMIC PERIOD.

AS TO THE ORIGIN OF MATTER.

What Scientists say :	*What Genesis says :*
The Universe is not eternal. It has its origin in the "First Cause," or "the Unknown Source of things." (Herbert Spencer.)	Ver. 1. In the beginning God created the heavens and the earth.
Tyndall says: "A Power inscrutable to the human intellect. There is no very rank materialism here."	

ITS PRIMORDIAL CONDITION.

The earth (and solar system) was, at first, a nebulous, i. e. cloud-like, mass, not solid, but mobile.	Ver. 2. The earth was without form, and void. (Not solid, but easily flowing, translated by "waters.")

AS TO LIGHT.

Prior to motion light was impossible; darkness enveloped everything.	Darkness was upon the face of the deep.

AS TO THE ORIGIN OF FORCES AND MOTION.

Nothing is known of this. It can only be referred to the same First Cause, "the Unknown Source of things" — the "Inscrutable Power."	The Spirit of God moved upon the face of the waters (i. e. the flowing mobile mass).

AS TO EFFECT OF MOTION.

The first visible effect of motion was the giving forth of light.	Ver. 3. And there was light.
It was perfect.	God saw it was good.

THE TELLURIC PERIOD

DIVIDED INTO TWO PARTS.

1. THE ANTE-LIFE PERIOD, OR IGNEOUS PERIOD.
2. THE LIFE PERIOD, OR AQUEOUS PERIOD.

ANTE-LIFE PERIOD.

IGNEOUS ACTION DOMINANT.

The earth was segregated from the great Cosmic, Nebulous Mass, and axial revolution began.	Silent.
After this segregation our world was a luminous vapor, or a comet, then a sphere of molten lava, continuing in each condition to emit light, as do Jupiter and Saturn now.	Silent.
The continued radiation of the earth's heat reduced its temperature at last, so far that a crust was formed on its surface, which, after a sufficient time, entirely stopped the radiation of light.	Silent.

DAY AND NIGHT EPOCH.

After this, for the first time in the history of our planet, light ceased to be universal, and there was a division between the light and the darkness, caused, as now, by the opaque body of the earth.	Ver. 4. And God divided the light from the darkness.
This was the beginning (not of axial revolution, but) of Day and Night. On the light side of the earth it was day while on the opposite it was night.	Ver. 5. And God called the light Day, and the darkness he called Night.
In the earliest epochs, the days and nights were equal.	The evening was (equal to one day) and the morning was (equal to) one day.

CONDITION OF THE EARTH IN THE INTERVAL BETWEEN THE BEGINNING OF DAYS AND NIGHTS AND THE DEPOSITION OF WATER.

For an unknown length of time the surface of the earth was too hot for the water to descend upon it, even as rain; but at last the super-heated invisible vapor became clouds or mist.

Chap. 2. Vv. 5, 6. "When the LORD God had not caused it to rain upon the earth, but there went up a mist from the earth and watered the whole face of the ground."

LIFE PERIOD.

Geology tells of two divisions of our world's ante-human history: the first characterized by uniformity of climate; the second by variety.

THE FIRST OR UNIFORM CLIMATE PERIOD.

AQUEOUS ACTION BECOMES DOMINANT.

Continued cooling at last brought a temperature sufficiently low to permit the waters to be deposited and remain upon the surface of the earth, and in consequence the air became so far cleared that the clouds were confined to its upper region, leaving an open space below them, and above the all-covering ocean.

Ver. 7. And God made an open space (or expanse) and divided the waters that were under the open space from the waters which were above the expanse.

Although this was done, yet from this time to a far later period, certainly till after the Carboniferous Age, the purification of the atmosphere was too incomplete to permit the higher orders of animals to breathe it.

"And it was so."

Note the absence of the usual formula of perfect completion. It is not pronounced "good." The writer merely adds, "and it was so," i. e. the open space was formed and the waters were deposited. He thus avoids chronological overlapping.

After this deposition, the air, although loaded with carbonic acid, was sufficiently clear to permit the free transmission of light, and for the first time the glories of the sky were visible from the earth's surface. The deposition affected both hemispheres.

Ver. 8. And God called the open expanse heaven.

'Twas evening and 'twas morning, the second day.

After this the continents were upheaved* and the seas gathered into their places.	Ver. 9. God said, Let the waters under the heaven be gathered into one place, and let the dry land appear.
The land is made up of large and small portions separated from each other by seas; but the waters, both seas and oceans, are really only one great body, with names for different parts.	Ver. 9. God said, Let the waters under the heaven be gathered into *one* place.
The arrangement of the land and water is surpassingly wise.	Ver. 10. And God saw it was good.
During the ever-growing "appearance" of the dry land the world was well peopled with the strange old forms of ancient life. Unnumbered races of plants and animals appeared, flourished, and disappeared, in an upward progression.	Silent.
At last vegetation reached its culmination in the "grasses, herbs, and fruit trees."	Ver. 12. And the earth brought forth grass, and the herb yielding seed after his kind, and the tree yielding fruit whose seed was in itself, after his kind.
The highest order of plants is the Angiosperms, which bear a fruit enclosing the seed.	Culmination in the "tree yielding fruit, the seed of which was in it."

* "Upheaved." Thus I wrote, but on reflection I saw physical objections to the word which, by a better selection, the author of Genesis had avoided.

The Record of the Rocks plainly intimates that the elevation of the dry land was no sudden movement, but had been going on during the previous epochs of cooling surface and falling water. When Geology first takes account of the continents, they are already lofty submarine plateaux, with here and there a projecting point of azoic rock, and needed to continue their upward movement at most a few hundred feet in order "to appear."

I have left the word as I wrote it, since it illustrates the surpassingly wise choice of words in the Mosaic Account. How wise that is can never be fully known until we know *all* the facts of the earth's primeval history.

These two great events, to wit, the completion of the continents in their full development, and the preponderance of grasses, herbs, and fruit trees, occurred in the same Geologic Period, the Pliocene.

These events affected both hemispheres.

Vv. 9–13. The Author has placed these events in the same period, for after announcing the verdict of completion he names but one day, "the third," in reference to both.

'Twas evening and 'twas morning the third day.

LIFE PERIOD.

THE SECOND PART OF THE LIFE PERIOD, OR THAT CHARACTERIZED BY VARIETY OF CLIMATE.

After the Pliocene came the epoch of the Glaciers.

Silent.

During its continuance such changes occurred as resulted in the modern type of climate with seasons and unequal days and nights, the former giving an easy and natural measurement of years.

Ver. 14. And God said, Let the lights in the firmament of heaven be to divide between the day and the night, and let them be for signs and for seasons, and for days and years . . . and it was so.

The Sun and Moon are not in themselves lights in the sense in which "Light" is used in Ver. 3, as most ancient and mediæval philosophers believed.

Light givers, light emitters, light bearers.

The obliquity of the Earth's axis, the cause of seasons and unequal days and nights, does not affect the length of a lunar revolution.

By what would once have seemed an unnatural omission of months, the Author avoids a blunder and shows his thorough knowledge of the subject.

The lines of the spectroscope, as well as the forms of the stellar orbits, show that the stars are composed of the same materials, and are subject to the same laws, as our earth, moon, and sun, and hence have a common origin.

Ver. 16. And God made two lights (the greater light to rule the day, the lesser light to rule the night). He made the stars also.

This change affected both hemispheres.

'Twas evening and 'twas morning the fourth day.

During the decadence of the Glaciers, the conditions of moisture

Silent.

and temperature must have been nearly identical with those which now exist in frigid or sub-frigid regions. Hence, in harmony with Uniformity of Law, we should expect a fauna similar to that now found in such places, i. e. an *abundance* of fish, sea-mammalia, fowl, and tiny molusks.

Ver. 20. God said, Let the *waters* bring forth *abundantly* the moving creature that hath life, and fowl that may fly above the earth.

Although, at first, the fauna must have been solely sub-frigid or frigid, yet as warmth extended, other water animals and other birds made their appearance, till every species now living occupied its proper place.

Ver. 21. And God created great whales, and *every* living creature that moveth, which the waters brought forth abundantly after their kind, and *every* winged fowl after his kind.

This stage of progress affected both hemispheres.

'Twas evening and 'twas morning the fifth day.

The waters, during the period of the melting glaciers, were comparatively soon ready for animal life, but the land required a longer time for preparation. It is therefore certain that land animals, such as the cattle and beasts of to-day, appeared *after* the water fauna. In reference to man and his interests, the animal world culminates in cattle, beasts, and insect life of to-day.

Ver. 25. God made the beast of the earth after his kind, and cattle after their kind, and everything that creepeth upon the earth after his kind.

Man appeared last, and is superior to all. He is gifted with intelligence and moral powers.

At the very end of all, the account says: "So God created man in his own likeness."

It is impossible to overestimate the excellence and wisdom displayed in the works of Creation.

Ver. 31. And God saw everything that he had made, and behold it was all very good.

This also affected both hemispheres.

'Twas evening and 'twas morning the sixth day.

No new animal or plant has appeared since the epoch of Man's Creation.

Chap. 11. Vv. 1, 2. Thus the heavens and the earth were finished and all the host of them. And on the seventh day God rested from all his work which he had made.

If from the second column the word "God" be struck out, and an abstraction be substituted such as "Nature," or "Law," or "Evolution," or that new and eminently theophobic word, "Dynamis," there will remain an account of the early history of our planet from the stand-point of extreme Positivism, in language at once simple, exact, and comprehensive.

It will aid in estimating the value of the evidence arising from the identity of the Science of Genesis with the latest acquirements of the Students of Nature, to note how the learning of a much later period bears the test of new discoveries.

Some fifty years ago, the learned men of that day essayed to write a work which should include the circle of knowledge. They produced the Encyclopædia Britannica. When near its completion four or five men distinguished for large acquirements and profound intellects, were selected to prepare introductory disquisitions which should embody the latest results and the choicest philosophy of the age.

Among them I find Sir John Leslie thus discoursing of the interior of our earth: *

"The vast subterranean cavity (of the earth) must be filled with a very diffused medium of astonishing elasticity. The only fluid of which we know, possessing this characteristic is light. The great concavity may thus be filled with the

* Vol. I. Ency. Brit., page 792.

purest ethereal essence, Light, in its most concentrated state, and shining with intense refulgence and overpowering splendor"!

Again we read, "But scattered over the immensity there may exist bodies which by their magnitude and predominant attraction, retain or recall the rays of light, and are lost in solitude and darkness. Had the velocity of the luminous particles not exceeded four hundred miles in a second, we should never have enjoyed the cheerful beams of the Sun. They would have been arrested in their journey and drawn back to their source before they reached the planet Mercury. A star similar to our Sun, and having a diameter sixty-three times as great, would entirely overpower the impetus of light"!!

If anything can exceed the certainty of his conclusions, it is the exactness of his mathematics!

Should the successors of such theorizers look down upon the Bible, and by their surmises and logic bar God out of His own world? reason Him out of His personality? bind Him in the swaddling-bands of the "Unconditioned," and make Him the only helpless being in the universe?

Nay, let them expend some of their acumen upon this fact, that a Hebrew prophet, a Hebrew Sheik if they please, amid a wandering, pastoral, semi-barbarous people, wrote from the depths of his own consciousness, or from a supernatural source, a philosophical treatise so profound that

no plummet has sounded it, clear as the waters from a spring, broad as the foundations of the universe.

In view of these harmonies, I submit that instead of "new meanings being necessary to make the beautiful myths and stories of the Bible square with Science," * the necessity has *always* been on the other side, and Science has but just struggled into a position, unwittingly I admit, where for the first time since her birth she has been able to approach the heights on which the Author of this Narrative stood four thousand years ago.

Since the chaos of Scientific Theories has crystallized into an order that accords with the opening Chapter of the Bible, may it not be hoped, in serious parody of Prof. Tyndall's words, that the time is not far distant when the best informed of our Philosophers shall admit that their views of the Universe and its Author are *not* improved by abandoning the Mosaic Account of Creation?

How far Moses himself understood the full meaning of the words he wrote, it does not pertain to my argument to inquire.

But as we are elsewhere told, the sacred writers desired to understand those things whereof they wrote, so I doubt not Moses learned all that was then possible.

* Tyndall, Forms of Water, page 150.

RESUME.

I NOW propose to tabulate the facts plainly stated in, or logically deduced from, the first chapter of Genesis. They have already been considered in detail.

GOD THE SOURCE AND CREATOR.

The earth had a beginning.

Primordially it was without form, void, not solid.

Prior to motion, darkness was upon the whole.

Motion is due to same Power as matter.

Light the first visible result of motion.

Light was perfected at that early epoch.

Light divided from the darkness, by the non-luminous earth.

"The evening" was equal to "the morning;" hence the earth's axis was nearly or quite perpendicular to the ecliptic.*

This division of light from darkness was the first day on our planet.

The water was deposited and the air became transparent.

This deposition and transparency were completed for all the globe simultaneously.

The land emerges.

The waters were gathered into *one* place.

* See Part III.

Vegetation culminated in the highest orders.

This vegetation (that of the Pliocene) was one "good" for present fauna, and was completed for the whole globe.

These two events, the emergence of the land, and the culmination of vegetation, occurred in the same epoch.

A great climatic change, introducing seasons, and unequal days and nights, came next.

The climatic arrangement (seasons, etc.) was then perfected, and was world-wide.

The Sun and Moon are not concrete masses of light, but simply luminaries.*

The stars have the same origin as the Solar System.

This climatic change was followed by a fauna of "living" species of water creatures and fowl.

This fauna is eminently gifted in the power of abundantly multiplying.

This fauna was then completed.

It was a world-wide completion.

After the water fauna and water fowl appeared present species of land animals, including the living beasts and cattle.

This fauna was eminently "good."

This introduction of modern species was world-wide.

MAN APPEARS,

and is the world-wide completion of the whole.

* Compare with this Sir John Leslie's Science, already quoted from the British Ency.

A cessation of new developments, whether inorganic, vegetable, or animal.

I ask the reader's careful attention to these facts in the light of all the Science he can bring to bear upon them; and while I dare not flatter myself that my analysis is in each particular correct, yet, after all deductions, so much remains as to make it worthy of most serious consideration.

These statements have been upon the Record nearly four thousand years. How came they there? Moses could have obtained them from no human source. There is, therefore, not an "Inscrutable Power" merely, but a Being who cares enough for Man to give him a Revelation. This Being has shown himself so truthful in regard to every point on which it is possible to test his statements, that we are, by the laws of our minds, compelled to receive his evidence in its entirety, and when he assures us that it is a personal God that created the heavens and the earth, there is no escaping the conclusion that this, too, is truth.

FACTS IN THE HISTORY OF THE WORLD DERIVED FROM THE TWO RECORDS,

Showing the Philosophical division into six great stages of development, each complete in itself.

NOTE.—The figures in brackets refer to the corresponding verses in Genesis.

(1.) God the First Cause and Source.

FIRST, OR PREPARATORY EPOCH.

(2.) A nebulous mass, without form, void, fluid, inert, dark. Temperature that of interstellar space.

Motion imparted. Activity commences. Temperature rises.

(4.) The nebulous mass emits light. Temperature far above 1000°.

Nebula becomes spheroidal; revolution commences.

Planets begin to be evolved.

Earth and Moon take form as a nebulous spheroid.

The Moon segregated from the earth; falling temperature.

The Earth becomes a sphere of liquid lava; temperature still falling.

The Earth, becoming cooled below 1000°, is covered with a dark, solid crust, and ceases to emit light.

(4, 5.) Day and night begin; are equal. Axis inclined about 5°.

This marks the close of the preparations for a true (i. e. non-luminous) planetary development. The "One day" of Genesis.

Close of First Epoch, or

that of general preparations. No new creation since of matter or force.

SECOND EPOCH BEGINS.

Surface temperature below 1000° and still falling.

Igneous action only. Geological Record not yet begun.

Combined igneous and aqueous action. Geology begins in Azoic Rocks. Temperature falling toward 212°.

(6, 7.) Water deposited. Temperature below 212°. The air becomes transparent. Light begins to act.

This ends the epoch, as is announced, for the entire globe, and the day of that announcement is the Second Epochal Day.

Close of Second Epoch,

or that of full preparation for joint action of water and light. Nothing more done since in that direction.

THIRD EPOCH BEGINS.

Aqueous action dominant; climate uniform from pole to pole; temperature below 212°, and falling. Stratified Azoic Rocks forming.

(9.) Land begins to appear, and about the same time the lowest orders of animal and vegetable life. Carbonic acid is taken from the air and deposited as coal or as carbonates. Archaic and Paleozoic fossiliferous strata form.

Emergence of the land continues; organic life expands into the first development of Angiosperms

and Palms. Cretaceous Period. Temperature tropical.

(10–12.) Land fully developed. Waters all connected into one.

Vegetation fully developed in predominance of grasses, herbs, and fruit trees (Angiosperms and Palms). Latter part of the Tertiary Period.

Temperature moderate; as yet no seasons.

The day of the announcement of these last developments, world-wide in its extent, was the third Epochal Day.

Close of Third Epoch, or

that of inorganic and vegetable development. No continental development and no higher orders of vegetation since.

FOURTH EPOCH BEGINS.

Temperature rapidly falls to below 32°. The end of ancient type of climate.

(14–18.) Era of axial (or other change) preparatory for and introducing modern type of climate, with seasons and unequal days and nights. Glacial Period. (16.) NOTE. He who made the Sun, Moon, and Earth, made the Stars also.

(19.) The day of the announcement of completion of preparations for modern type of climate (axis inclined 23½°), extending over the whole Earth, was the fourth Epochal Day.

Close of Fourth Epoch, or

that of Climatic development. No change since in that direction.

FIFTH EPOCH BEGINS.

(20–22.) The ice of the Glaciers begins to melt. Close of Glacial Period and beginning of Champlain Period.

(25.) Appearance of fauna of "living" water creatures and fowl. Announcement of completion of "development" of water creatures and fowl for all the world.

The day in which this was done was the fifth Epochal Day.

Close of Fifth Epoch, or

that of water fauna. No higher development of water fauna has since occurred.

SIXTH EPOCH BEGINS.

Temperature somewhat warmer than the present.

(24–25.) Culmination of land animals in "living" species of beasts, cattle, etc., in latter part of Quaternary Age.

(26.) Man appears very late in the Quaternary Age. Present temperature, nearly.

Announcement of entire completion of the whole plan over all the earth. The day this occurred was the sixth Epochal Day.

Close of Sixth Epoch, or

that of final culmination, in the Mammalia, and in MAN.

No higher animal development has since occurred.

CHAPTER V.

ON THE SECOND CHAPTER OF GENESIS.

SINCE the truth or falsehood of the opening Chapter of Genesis is independent of all that comes after it, being capable of verification by itself, I had thought not to speak of the Second. But the one casts light upon the other, so that the omission of either leaves the subject incomplete, and, indeed, in part unintelligible.

The first three verses of this chapter are clearly a part of the preceding account. As to the fourth, fifth, sixth, and perhaps the seventh, there is among Bible students a difference of opinion, some regarding them as the end of the first account, others, as the beginning of the second. To me it appears that they are both, partaking of the characteristics of each, connecting the two, the Elohistic and the Jehovistic, by an indissoluble bond, affirming that the God of creation and the Jehovah-God, or the God of the Covenant, are one.

There is here, moreover, the same surpassingly wise choice of words. "These are the generations of the heavens and of the earth," or, as others translate it, "These are the genealogies," etc. The sense is the same.

There is a wealth of meaning in this phrase. I know of no words that convey so much, so accurately as these. If the Author had said, "this is the history of the heavens and the earth," or, "this is the chronology of the heavens and the earth," he would barely have told us of events in succession. But "generations" implies that in the strongest possible manner, with the added information of a serial development, a dependence, an outgrowth, one stage of progress the result of that which preceded, and in these combined the highest scientific summation of the results of human knowledge.

On the use of "day," in the fourth verse, I have already spoken.

The remainder of this connecting bond, v. 5, v. 6, condenses all before Adam into a few lines, cramped and foreshortened by the small space into which the story is compressed. The writer, then, starting with the creation of man, v. 7, gives a more extended account of various events which took place in the last creative epoch.

In these verses (4–7) the Author sets forth the LORD God's universal creatorship, from the greatest, i. e. "the heavens and the earth," to the least, i. e. to "the plants in the field," and then his eternity, as shown by the remoteness of the creation. It was before the plants were in the earth, or herbs began to grow, before man appeared to till the ground.

In the fulness of his overflowing knowledge, the Author interjects a clause which no man before the present century could comprehend. He says "it was before there was any rain upon the earth, when the earth was clothed in mists," i. e. far back in the remote epoch before the earth had so far cooled as to permit of rain, before the firmament had divided the waters, before Geology begins to compute its Cosmic Chronology. Then, passing by a natural transition from one extreme to the other, he comes to this end of creation and tells us all we can ever know of the formation of Adam, after which he records certain subsequent events, closing with the institution of marriage.*

In the following paraphrase I have endeavored to bring out more fully what appears to be the meaning of these verses. In the fifth verse I have substituted "when" in place of "for." It is very difficult to see any force in the causative conjunction. An examination of the original will show that the reader is not limited to that signification, since the same word is often used as an adverb of time, and is so translated in many places. Examine Genesis iv. 12, and Job vii. 13. These are sufficient to show the usage. The identical word rendered in the Second Chapter of Genesis "for," is, in the cases referred to, rendered "when." Hence, evidently, the reader is

* See Part II. for an article on the chronological arrangement of these two Chapters.

at liberty to use the meaning which, in view of all the facts, appears to him the best.

PARAPHRASE.

"These *statements in the first Chapter*, are the generations of the heavens and the earth, *setting forth the order in which* (i. e. when) they were created, in the day (*time unlimited*) the LORD God made *all things*, *even* the earth and the heavens, *the extremes of greatness*, *down to the least*, *even* every plant of the field, *going back into the eternity* before it (the plant) was in the earth, and every herb of the field before it grew, *back to that remote period* when the LORD God had not caused it to rain upon the earth, and there was not a man to till the ground, but a mist went up to water the whole face of the earth." Passing over all the intermediate ages, the Author comes down to the creation of man, and says, "And the LORD God formed man out of the dust of the ground, and he breathed into his nostrils the breath of life, and man became a living soul."

All agree that Man is formed out of the dust of the ground, that into his nostrils is breathed the breath of life, and that he is a living soul. To this Science can add nothing, but busies itself with considering whether the dust was taken directly from the ground, or mediately through ordinary generation, by some beast, either in embryo or in youth; and if, as so many now claim,

the latter be the truth, whether this change from a brute to a man was due to a greater or less abundance of food, or to something else affecting the vitality of the parent beasts. The advocates of this theory of the evolution of man from a beast, here divide into two parties, the one referring this upward development to an Intelligent Power, the other acknowledging a Power, but ignoring all intelligence or other indication of personality. These suppose that all evolution comes either by chance or by the action of a law implanted in the Cosmic atoms in the origin of the universe. This law of evolution, they claim, produced an infinite number of orders and classes and species, previous to the historic period, but since that it has ceased to act, resembling some birds that will not lay if watched.

The narrative offers in the eighth verse, a statement that seems directly antagonistic to our previous beliefs, but, if "it means just what it says," marvelously in harmony with results of modern scientific investigation, results arrived at within the life of the present generation.

Verse eighth reads, "And the LORD God planted a garden eastward in Eden, and there he put the man he had formed. (V. 9.) And out of the ground the LORD God made to grow every tree that is pleasant to sight and good for food," etc.

From this it follows, that the creation of plants

did not cease at the close of the third period, and that in Eden at least, there was a special centre of plant creation. If there was one, may there not have been others? and is not such a fact eminently in harmony with the modern scientific belief, that plants and animals (v. 19) were created not all in one place, but at various centres scattered over the world?

There were also planted in the midst of the Garden, two mysterious trees. Of one, the name only is given, the tree of life, and afterward it is spoken of as if it had power to make our first parents "live for ever." As to this, I have no explanations to offer or suggestions to make. I accept the account as true, however, on the ground that One who has told *vera verissima*, the great truths of earth's primeval history, had no occasion to err in this.

I may, however, say that, although we know of no tree that heals all diseases, we do know of one that heals very many, and that, furthermore, no chemist knows why the bark of the Peruvian tree heals so many ailments, nor can he affirm that God exhausted his power when he created it.

As to the Tree of Knowledge of Good and Evil, we know the sad story. Certainly there is no impossibility in such a test of obedience, and as to the dignity or worthiness of such a trial, that is not a question for us to decide, and surely it has no bearing on the truth of the narrative.

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Vv. 10–14. The writer mentions four rivers, which to those familiar with the geography of that country, sufficiently indicated the position of the Garden. Two of these we can now identify, the other two may have been two arms into which the Euphrates may have divided, as do the Nile, Ganges, and many other rivers; or they may have been simply the shores of the Persian Gulf, running off like river banks, to the right and left, as so ably argued by Prof. Tayler Lewis in Lange's Commentary.

Vv. 15–17. In these I find statements on which science has no bearing, and consequently cannot affect this argument. I will, however, say that I see in them nothing inconsistent with the philosophy of the mind or the relation of God as a Father to his children. On some future occasion, I hope to speak more fully on this subject.

V. 18. "It is not good for man to be alone." Science and reason reaffirm this truth. A companion is necessary for man's highest development.

V. 19. In this we are told that "out of the ground the LORD God formed every beast of the field, and every fowl of the air." That this is a different creation from the one spoken of in the previous chapter (vv. 20, 25) is certain, because these are *all* land animals, or at least *land*-formed, while the fowl in the other account are water-fowl, or at least the *waters* brought them forth.

V. 20. Adam gives names to all cattle, beasts of the field, and fowls of the air. Nouns precede other parts of speech. Adam had all the apparatus for speaking. This was merely the occasion for its use. Brutes lack this power, and no opportunity however favorable, no need however great, has yet developed it.

I suppose all Scientists will admit the truth, that among all these beasts there was not found "an help meet for man."

Vv. 21–22. In these is given an account of the formation of woman from a rib taken from Adam.

Mysterious as this appears, its mysteriousness is in its uniqueness, and not in any intrinsic quality of its own. It is strictly in accordance with the processes of life as revealed by modern scientific research.

Only two modes of propagation are known, the one requiring the coëxistence of two individuals of opposite sexual characteristics, the other by "fission" spontaneous or artificial.* Indeed, the former in the last analysis of microscopic investigation is only a form of the latter.

Generation by "fission" is now constantly going on in many of the lower orders of animals as well as in the propagation of plants by cuttings.

* If monogamic generation exists, it is only apparent, for there is in all cases really a duality of formation, two individuals joined into one.

Adam was the only one of the race. The Divine Worker, in accordance with his habit of working through his laws, chose the only method in existence among his creatures, which the nature of the case rendered possible, a method which He himself had introduced into the world, and with which He was infinitely familiar. So from a portion of Adam, "a rib," "made He a woman." A miracle indeed, but a miracle conforming as far as the conditions permitted to methods already in use.

After this follows the gift of Eve to Adam, his reception of her as bone of his bone and flesh of his flesh.

A statement of the intimate union of the conjugal relation, and of the purity and innocence of the pair, closes the chapter.

This ends the history of Creation.

PART II.

CONTAINING EIGHT STUDIES ON THE

THE FIRST TWO CHAPTERS OF GENESIS

IN WHICH

THE PHOTOGRAPHIC TRUTHFULNESS OF THEIR STATEMENTS IS ASSUMED

As Astronomers will soon study the photographs of the coming Transit, applying to them the micrometer and microscope, to test old theories and to develop new ones, so have I studied, as I was able, these logographs of an ante-human world.

See note, page 48.

A HARMONY

OF

THE FIRST TWO CHAPTERS OF GENESIS.

THE two accounts are here arranged chronologically, with an attempt to indicate intervals of time by blank spaces between the paragraphs. Of the duration of these, Moses gives no intimation, and I gather it wholly from God's other Record. This much, however, is certain, the announcement or command, "Let it be so and so," marks the beginning of a creative epoch, as the words, "and it was so," or "God saw it was good," mark its close. After these there is some remark added, either as an additional fact (v. 4, 5, and v. 8, v. 10), or a more explicit statement of the work done (v. 12, v. 21, 22, 25); or repeating and enlarging with special emphasis (v. 16–19), followed in every case by an announcement of the world-wide extent of the work in that "'twas evening and 'twas morning" at the moment the Divine Architect pronounced each epoch ended, the work completed which was foreshadowed in the opening words.

I have made some verbal changes that the original seems to demand, following the peculiar

wording of the "day clauses" as far as our language will permit.

I have left untouched the imperative form, as it does not seriously affect the meaning, a command, in God's utterances, being simply another mode of stating His own purpose.

I should prefer, but for the hoariness of antiquity which has gathered about these phrases, to render the future form simply by our English future.

For a like reason I have retained the word "firmament." It is now so well understood to be an improper translation of a word meaning "expanse" that there is no danger of mistaking the true sense. Indeed, to most English readers it no longer conveys the idea of solidity.

In regard to the fourth day, I have already given at considerable length my reasons for the translation which I employ. The present rendering does violence to the Hebrew and to God's other Record.

I have placed immediately after each announcement of completion, the command (or, so to speak, the programme) for the next creative stage, in the belief that there were no gaps in this work, but a continuous development of God's plans.

Here I may remark that the earlier stages were of immensely longer duration than the later ones. In fact, it is difficult, if not impossible, to distinguish any intervals in the last three periods.

GENESIS, CHAPTERS I. AND II.

1 In the beginning God created the heaven and the earth. (2) And the earth was without form and void, and darkness was upon the face of the deep.

. . . . . .

. . . . . .

And the spirit of God moved upon the face of of the waters.

3 And God said, Let there be light.

. . . . . .

. . . . . .

And there was light. (4) And God saw the light that it was good.

. . . . . .

. . . . . .

And God divided between the light and between the darkness. (5) And God called the light Day, and the darkness he called Night. And the evening was, and the morning was one day.

6 And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters.

. . . . . .

. . . . . .

7 And God made the firmament, and divided the waters which were under the firmament, from the waters which were over the firmament: and it was so. (8) And God called the firmament heaven. And 'twas evening and 'twas morning the second day.

9 And God said, Let the waters under the heaven be gathered together into one place, and let the dry land appear.

. . . . . .

. . . . . .

And it was so. (10) And God called the dry land Earth; and the gathering together of the waters, called he Seas; and God saw that it was good.

11* And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit-tree yielding fruit after his kind, whose seed is in itself, upon the earth:

. . . . . .

. . . . . .

and it was so.

12 And the earth brought forth grass, and herb yielding seed after his kind; and the tree yielding fruit whose seed was in itself after his kind. (13) And God saw that it was good. And 'twas evening, and 'twas morning the third day.

14 And God said, Let it be that the lights in the firmament of the heaven divide† between (margin) the day and the night,‡ and let them be

* Verse 11 in chronological order comes between verses 9 and 10. But this order is for the sake of brevity and clearness held for the moment in abeyance, all danger of error being avoided by placing both completions in one "day."

† Or "Let the lights in the firmament of heaven be to divide," etc.; either form harmonizes with the idea of appointment so evident in the next two clauses.

‡ A father divides his property between his two sons; so the sun and moon divide their influence, their light, between

for signs, and for seasons, and for days, and years; (15) and let them be for lights in the firmament of the heaven to give light upon the earth:

. . . . . .

. . . . . .

and it was so.

(16 And God made two great lights; the greater light to rule the day, and the lesser light to rule the night, the stars also. (17) And God set them in the firmament of the heaven to give light upon the earth; (18) and to rule over the day and over the night, and to divide the light from the darkness.)

19 And God saw that it was good. And 'twas evening, and 'twas morning the fourth day.

20 And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly in the open firmament of heaven.

21 And God created great whales, and every living creature that moveth, which the waters brought forth abundantly after their kind, and every winged fowl after his kind.

22 And God saw that it was good. And God blessed them saying, Be fruitful and multiply and fill the waters in the seas, and let fowl multiply in the earth. (23) And 'twas evening and 'twas morning the fifth day.

the day and the night, giving to each its due share. Up to this, I take it, their shares were equal. Now they are to vary.

24 And God said, Let the earth bring forth the living creature after his kind, cattle and creeping thing and beast of the earth after his kind.

. . . . . .

. . . . . .

25 And it was so. And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth, after his kind: and God saw that it was good.

Chap. II., v. 4–6. These are the generations of the heavens and of the earth when they were created, in the day the Jehovah God made the earth and the heavens, and every plant of the field, before it was in the earth, and every herb of the field, before it grew; when the Jehovah God had not caused it to rain upon the earth and there was not a man to till the ground, and there went up a mist from the face of the earth and watered the whole face of the ground.

Chap. I., v. 26. And God said, Let us make man in our image and in our likeness; and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth.

Chap. II., v. 7–25. And the Jehovah God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and man became a living soul.

And the Jehovah God planted a garden east-

ward in Eden, and there he placed the man whom he had formed. And out of the ground made the Jehovah God to grow every tree that is pleasant to the sight, and good for food; the tree of life also in the midst of the garden, and the tree of knowledge of good and evil. (Vv. 10, 11, 12, 13, 14 describe the situation of the garden.)

And the Jehovah God took the man, and put him into the garden of Eden to dress it and to keep it.

And the Jehovah God commanded the man, saying, Of every tree of the garden thou mayest freely eat; but of the tree of the knowledge of good and evil thou shalt not eat of it; for in the day that thou eatest thereof thou shalt surely die.

And the Jehovah God said, It is not good that the man should be alone; I will make him an help meet for him.

And out of the ground the Jehovah God formed every beast of the field, and fowl of the air; and brought them unto Adam to see what he would call them; and whatsoever Adam called every living creature, that was the name thereof.

And Adam gave names to all cattle and to the fowl of the air, and to every beast of the field; but for Adam there was not found an help meet for him.

And the Jehovah God caused a deep sleep to fall upon Adam, and he slept; and he took one of his ribs and closed up the flesh instead thereof.

And the rib which the Jehovah God had taken from the man, made he a woman and brought her unto the man. And Adam said, This is now bone of my bone and flesh of my flesh; she shall be called Woman, because she was taken out of man. (Therefore shall a man leave his father and mother, and shall cleave to his wife, and they shall be one flesh.)

And they were both naked, the man and his wife, and were not ashamed.

Chap. I., v. 27–31. So God created man in his own image, in the image of God created he him; male and female created he them. And God blessed them and God said unto them, Be fruitful and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.

And God said, Behold, I have given you every herb bearing seed which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed; to you it shall be for meat; and to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat; and it was so.

And God saw every thing that he had made, and behold, it was very good.

And 'twas evening and 'twas morning the sixth day.

Chap. II., v. 1–3. Thus the heavens and the earth were finished and all the host of them.

And on the seventh day God ended his work which he had made; and he rested on the seventh day from all his work which he had made. And God blessed the seventh day and sanctified it; because that in it he had rested from all his work which God created and made.

THE PERSONALITY OF THE MOSAIC ACCOUNT OF CREATION.

After writing Chapter IV. of this essay, it occurred to me that the Scientific truth and order of the events recorded might be evident to some minds, if some other word should be substituted for the name of God.

I commenced what might be called an impersonal Genesis. But the Narrative refused to be so treated. I was met at every step by an ever-living personality that flashed forth from almost every phrase. It quickly brought me to a stand and compelled me either to give up the attempt or to omit large portions of the account. What filled me with surprise was that those words which before had appeared almost needless surplusage, were the very ones that baffled all my efforts.

Let the reader attempt this for himself, selecting any one of the terms used by theophobists in place of "God."

Let him take the most unpromising and, for

this purpose, the most awkward of all the expressions so employed.

In the beginning Natural Causes created the heavens and the earth.

And the earth was without form and void; and darkness was upon the face of the deep. And the Spirit of Natural Causes moved upon the face of the waters.

And Natural Causes said, Let there be light, and there was light. And Natural Causes saw the light that it was good. And Natural Causes divided the light from the darkness. And Natural Causes called the light Day, and the darkness he called Night. . . . And Natural Causes said, Let there be a firmament. . . . And Natural Causes made a firmament. . . . And Natural Causes called the firmament Heaven.

We have gone thus through but a fragment of the narrative, and the abstraction has vanished, and in place of it there is the designation of a living, acting person. If the reader will continue the substitution to the close of the chapter, he will find the personal element intensified until in the twenty-sixth and following verses it culminates in the mysterious first person plural, the Father who forms man in his likeness, and blesses and endows him.

If, then, the outline of physical events here recorded, be true, both as to the events themselves and the order of their occurrence, then must it be equally true in its evidence as to the personality of the First Cause. The two are so interwoven that separation is impossible.

"Dynamis" has been adopted by some as an

eminently fit name for the "First Cause," as eliminating all associations with personality. But if it be employed in this narrative in place of "God," it shares the fate of "Natural Causes" and becomes only a title of an intensely personal Being.

Nor is this name "Dynamis," anything new. The pantheistic writers who adopt it, possibly may be surprised to learn that precisely the same word (in Hebrew) was employed by Moses in this very narrative.

"Elohim," the word he employs, translated "God," means "Forces," or Dynamis in the plural; i. e. all-powers combined.* The account itself adds the needed personality to make the word properly characterize the God of the Hebrews, the God of Creation.

GOD'S VERDICT OF APPROVAL, "AND GOD SAW THAT IT WAS GOOD."

This formula occurs six times in the first chapter, while a higher approval, "very good," occurs but once, and there are four divine acts that do not receive any such meed.

What fact underlies this distinction? What does the author mean by "good"? Certainly not any moral quality, since none can be pre-

* See Lange on Genesis, page 109, on the *meaning* and *derivation* of Elohim. Also Dr. Lewis' note, same page.

"Power, greatness, vastness." "Our terms, infinite, absolute, etc., add nothing to these in idea."

dicated of light, nor of land and water, nor of the other things done, or creatures created, before man.

A good machine is one so thoroughly finished in all its parts and arrangements, as to do the work for which it was intended. A western pioneer calls his farm a good one, when he has removed the forests, and brought the land into a condition fit for his purposes.

The work in which the Almighty is represented as employed, was that of bringing our world from its primary formless, empty, dark state, to a condition fit for man. In itself considered, every act of God is good, being perfectly fitted for the purpose he has in view; but in reference to completion for the use of the coming race, many things were but stepping-stones to something better.

I think I see in this why so many divine acts are left without the word of approval, and why others receive it.

Let us see how this agrees with the account, and with the physical facts.

No. 1. "In the beginning God created the heavens and the earth." Not pronounced good, since it, the Cosmos, was not ready for man's use, being in a Nebulous condition. It required a long course of perfecting.

No. 2. Motion imparted.

Not pronounced good, because it was only germinal of future results. Not motion or force in a shape that man could use.

No. 3. Light came into existence.

Pronounced good, because light has no stages of progress. It was perfected at once, ready for the future man and organic life. No improvement has since been made in it.

No. 4. Beginning of days and nights.

Not pronounced "good," as the axis was yet to be bent farther from the perpendicular, to give varying length of days, and to cause seasons, a change that occurred long afterwards.

No. 5. Deposition of water, and formation of a clear expanse, being the preparation of the atmosphere for the transmission of the solar rays.

Not pronounced good, because the purification was not completed till long afterwards.

No. 6. The appearance of the dry land, and the formation of the oceans.

This is pronounced good. No change, Geology tells us, has taken place in the plan since the foundations were laid in the azoic rocks, nor any considerable upheaval or enlargement since its completion in the Tertiary. It was then in its general arrangements and outlines ready for man.

No. 7. Production of grasses, herbs, and fruit trees.

Pronounced good, because no farther advance was needed to fit the vegetable world for man, and the cattle and beasts, the fauna, to him objects of the greatest interest. Angiosperms and palms are the highest developed of the vegetable world.

No. 8. A climatic change introducing unequal days, seasons, and measurement of years, really an increase of axial inclination.

Pronounced good, because no further change was needed to provide modern climate for man. No change in that direction has since occurred.

No. 9. Production of "living" species of fowls, fish, and moving things, of aquatic habits.

Pronounced good, because they marked the completion of those orders of animal life for man's use. No higher orders since.

No. 10. The production of mammalia, and increased development of lower orders of terrestrial animals.

Pronounced good, because no further improvement was contemplated. They were ready for man. No higher orders since.

No. 11. The Creation of Man, the making of the garden with its peculiar fauna and flora, the formation of Eve, and the institution of marriage.

These mark a higher and nobler culmination, a crown of glory to the hitherto brute world, a work which God does not call upon nature to perform, but which God is represented as doing solely himself.

This, in a higher sense of satisfaction and completion, God pronounces, Very good.

THE DIVINE MONOLOGUE.

In the Narrative, God is represented as speaking. Was there actually a sound, a voice? It would seem that there was. God afterward spoke with human voice to Adam and Eve, to Moses upon the Mount, to the children of Israel, and to many of his people down through the years of Jewish history.

Whether he spoke with a voice or not, the intense literalism of the whole induces me to believe that by means equivalent to speech he did convey to some audience the sense which we find in the written narrative. Nor are we left to conjecture who the audience were, in whose ears sounded the divine announcements of his purposes. Ten times we read "And God said." Twice out of these, he speaks to Adam. In the other eight, no listeners are mentioned, but we know there was an eager, attentive, sympathetic audience, for the Almighty himself tells us, that when "he laid the foundations of the earth, when he laid the measures thereof, and stretched a line upon it," "the Sons of God shouted for joy."

There seems an incongruity between the photographic realism of the account, and the form of expression attributed to God in our English Version, where he is represented as commanding matter as if it was a sentient being, able of itself to obey, as when he says, "Let the earth bring

forth," or stranger still, when he commands the non-existent to exist.

"Let there be light."

Such expressions would befit a poem abounding in the bold imagery of the East, but seem strangely out of place in a description whose prose literalism in every other respect is simply wonderful.

But when we read in the Hebrew Grammar that there is no imperative form in that language for the first or the third person, but that the future is employed, and that the translator is guided only by his judgment, i. e. by subjective reasons, whether to render it by the future or by the imperative, the incongruity vanishes.

The translators may have been transcendent Hebrew scholars, but they allowed their notions of what Moses ought to say, to lead them so far astray as to mistranslate "expanse," or "open space," by "firmament," something solid. Although the Septuagint and all other ancient versions accord, it will not be presumption to question their accuracy in a matter in which they had nothing but their beliefs, scientific or metaphysical, to guide them. Even that critical tact which comes from long acquaintance with a language, may be an unsafe guide if tempered with incorrect ideas of creation, or of God's manner of working. The only safe course would have been to translate the text as Moses wrote it, calling an

"expanse" an "expanse," and a future tense a future tense.

Read in this sense, the intense realism of the Narrative is without alloy.

Instead of commands to non-existences or to inert matter, we find announcements of Divine purposes, a series of prophecies, which are in due time fulfilled, as is related in a succeeding verse.

I may be mistaken, but it seems to me infinitely more sublime for the Divine Architect to calmly announce his purposes, and record that he has accomplished them, than to think of him as giving forth a command to matter to do a thing which matter cannot do, and which, after all, God himself does.

As to the statement that St. Paul says "God commanded the light to shine out of darkness," * it is probably a sufficient answer to say that the Apostle quoted in substance from the Septuagint, the Bible then in common use. I might add what every scholar knows, that εἰπὼν is not properly a word of command at all, but rather of narration, and is so rendered in all the four hundred or more times it occurs in the New Testament, save three or four.

THE SPIRIT OF GOD MOVED UPON THE FACE OF THE WATERS.

In the first verse God creates, in the third, the Spirit of God acts. Why this distinction? Per-

* 2 Corinth. iv. 6.

haps the character of the two things done, as revealed by the New Chemistry as already quoted, will give a good explanation. If all qualities of matter be the results of one substratum modified by the varying play of one force, the imparting and regulating this force was an operation requiring, as far as we can judge, infinitely more of what we should call in a man, intellect, than the act of generating the material on which the force was to act. The matter was inert, dead, formless, the force imparted to it, *if Evolutionists are right, contained in germ*, the future creation. The first act was, so to speak, merely physical. The second laid the foundation, planned the future Cosmos and its inhabitants, endowed its atoms with powers fitted for their mission, set a compass upon the face of the depth, prepared the heavens, and laid the foundation of the earth. The former was, so to speak, the work of the Almighty hand ; the latter, the work of the Almighty mind, that is, the Spirit of God, surpassing the other as mind surpasses body.

The statement recorded by Moses is, then, an assertion that the imparting of these forces was not the work of mere Power or Law, but a positive exercise of intelligence, purpose, will,—all that constitutes personality.

ON THE "SIX DAYS" OF THE FOURTH COMMANDMENT.

"For *in* six days the LORD made heaven and earth, the sea and all that in them *is*, and rested the seventh day." (Exodus xx. 11.)

"For *in* six days the LORD made heaven and earth, and in the seventh day he rested and was refreshed." (Exod. xxxi. 17.)

I cannot feel that I have done full justice to this question, as to the length of the Mosaic "days," in its broadest meaning, without considering more fully the belief which certainly exists, that God intended to convey the impression that the world and its contents were formed in six consecutive days, and *not* within six days separated by intervals of unknown length.

Affirming the incorrectness of such a belief is no more an impugnment of the written record, than is a statement of the true magnitude of the stars a contradiction of Nature. In both there is an apparent meaning which a more careful examination corrects. The question is not in either case, what, with views limited by ignorance or disturbed by previous beliefs, we may think was meant by "six days," but what, in the light of all knowledge, these words represent. Astronomy would have made little progress had philosophers in their faith in the veracity of Nature accepted appearances as ultimate truth.

Throughout that narrative, which as God's

sign-manual is placed on the first page of Revelation, a literal realism is found absolutely unapproachable by any human document; but elsewhere God often employed expressions clothed in metaphor of every degree of boldness. Christ's conversation abounded in them. He called himself a door, a vine, a lamb, and many other names. But he was not careful to use only such metaphors as could not be misunderstood.

When the Jews in the temple asked for a sign, he replied, "Destroy this temple and in three days I will raise it up again." Their answer proves that his words had been misunderstood, and he must have known it, but he vouchsafed no explanation. In Ex. xxxi. 17, God says he "was refreshed." Being "refreshed" is evidently spoken after the manner of a man coming down to the level of his hearers.

These will suffice to show that first impressions are often wrong, and that we are to test them in all possible ways. No encouragement is given to mental indolence.

My reasons, then, for believing that the Commandment was not intended to teach a creation in six *consecutive* days, are as follows: In Genesis there is no assertion that anything was made *on* any of the "days." It is affirmed that on each "day" God saw the completed progress and pronounced it "good."—that is all. In the second chapter, we are told of "*the day*" in which *all* things were made, as if to forbid the belief that

the previous days were days of creation. Ex. xxxi. 17, as already shown, could not possibly have been intended to mean what the Hebrews understood from it, viz., that God "was refreshed," "took breath," as the Hebrew has it. The preposition "in" does not occur in the phrase, "for *in* six days," as is shown by the italics in our version. The writer says, "God made heaven and earth and all that in them is," in some relation to "six days" (Hebrew, "six of days," i. e. a series of six days?) and leaves us to discover what that relation is. As there is no anachronism in imputing to God the knowledge of modern Science, we may take his words from our highest present standpoint (infinitely below His), and supply the ellipsis by that word which, in view of *all* the facts, best represents the true relation. By "heaven" is meant here, as I think, the firmament or open space in which the birds fly. If so, then the proper preposition appears to be "within," making it read "for *within* six days," etc. It was after the "*one day*," that God made the firmament, and it was *before* the day of announcement of final completion that he made "all that in them is." In this, too, was included the making (*not the creation*) of the earth to be a habitation for man. Thus the entire transaction is brought *within* the "six days."

It is clear, then, that God intended to impress most strongly the observance of the Sabbath in commemoration of his creating all things. To do this he used a form of expression most fitted for

his purpose, yet so guarded that the thoughtful mind earnestly seeking the truth, and collating God's two Records with each other, need find no contradiction.

ON THE CHARACTER OF THE PLANTS AND ANIMALS OF THE GARDEN OF EDEN.

The intense realism of the Mosaic Narrative seems to suffer a shock in the twenty-ninth and thirtieth verses of the first chapter, where we are told,

"And God said, Behold I have given you every herb bearing seed which is upon the face of all the earth, and every tree in which is the fruit of a tree yielding seed; to you it shall be for meat; and to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth wherein there is the breath of life, every green herb for meat; and it was so."

In these verses I find two difficulties. "Every herb bearing seed" and every tree yielding fruit are said to be given to man for "meat," i. e. he is to eat them and be sustained and nourished by them, and yet we well know that there are herbs and trees which are injurious or even destructive to him. We are also told that "every green herb" was to be "meat" for all the animals, while we know that to the carnivorous animals such a diet means death by starvation. Nor is it

any answer to say that *all* seeds and fruits were then non-injurious, for of that we have no proof, and the Bible and Science have both suffered too much from positive assertions, whose only foundation was a desire to say something to cover up the speaker's ignorance. I trust the day has gone by for the invention of Scientific or Theological facts.

Moreover, since many animals feed upon plants poisonous to man, such a supposition requires us to believe that the injurious plants and the creatures that feed upon them, were created after the fall, i. e. after the "rest" of the seventh day.

As to the Carnivora, we *know* they lived long before Adam. Modern Chemistry has shown that they through the herbivorous animals, derive their food from the "green herb," and I doubt not this modern discovery was well known to the Author of the Narrative, and helps explain the apparent universality of his assertion; but I do not think Adam and Eve so understood it. There must have been some other meaning, not inconsistent with this, which readily suggested itself to their minds.

This other meaning I seek. To be satisfactory it should be drawn from the narrative itself, or from admitted facts. In this inquiry we shall derive much assistance from the next chapter. I assume both to be *true;* as true and a hundred times more true than Humboldt's Cosmos, or any merely human narrative.

Looking now at the twenty-seventh verse, we read, "So God created man in his own image, in the image of God created he him." At this point of time the events of the next chapter come in, from the creation of Adam in the seventh verse, or rather from his being placed in the garden, up to and including the creation of Eve—for it adds, "male and female created he them," and the creation of Eve and her union to Adam are the last events mentioned in this Chapter.

In the verses 8 and 9, Chap. II., we are told God planted a garden and placed in it the man whom he *had* formed, i. e. previously formed. "And out of the ground made the LORD God to grow every tree that is pleasant to the sight and good for food." . . . After which, if we may judge from the apparent order (which if our Witnesses be reliable, has in every case hitherto been the true one) this happened (remember the sixth day is not yet ended nor Eve created), v. 19, "And out of the ground the LORD God formed every beast of the field and every fowl of the air." Note here the absence of fishes and all water animals which would have been inappropriate in a description of the animals of Eden. After the formation of these animals, God formed Eve from Adam, and subsequent to that gave to them (not to Adam alone) dominion over all animate beings.

In verse 29, God told them that all fruits were for their meat and all green herbs for the animals.

It seems from this address, and from the account given in the next two chapters, that God did appear in some form, probably in human shape, and talk to and with Adam and Eve. His language must have been adapted to their ideas and capacity. He first gave them a grant of "dominion over the fish of the sea, the fowl of the air, and over every living thing that moveth upon the earth."

Subsequently to this gift, it may have been an hour or a day, or longer, God again speaks to Adam, to whom Eden, extending from horizon to horizon, was the "whole earth," and tells him that in all that space there were no injurious plants, but all were either "pleasant to the eye or good for food," and that he might safely eat of all, save one which was reserved for other reasons than the possession of any poisonous quality. Moreover, among all the beasts, birds and creeping things upon the face of the whole earth, there was not one that would injure him; there was not a carnivorous creature among them, for none of them ate flesh, but all lived upon vegetation, even "every green herb," such animals as we now style herbivorous.

This seems to me to solve the difficulty. There was a special creation of plants and animals for the Garden, an idea eminently in harmony with present scientific belief that, as a general thing, the flora and fauna of each great section originated in that section.

The entire flora of the Garden consisted of "trees pleasant to the sight and good for food," as well as "herbs bearing seed," and "grass," and consequently free from any admixture of noxious species. Their "fruit" was to be Adam's "meat."

The animal world of that region was in harmony with the vegetable. All ferocious, flesh-eating creatures were excluded. Neither predacious birds nor beasts were found within its limits. The only fauna were those which subsisted upon the "green herb for meat."

This realism destroys the poetry which represents the lion and the lamb, the leopard and the kid living harmoniously together; but it is based on the words of Moses, and contradicts no facts of Scripture or Science.

The other explanation requires us to believe that carnivorous animals at that time flourished on food on which we know they would now starve to death, or that carnivorous beasts did not then exist. The first would require a suspension of the laws of animal life, and the second contradicts the explanation itself.

As to a four-legged creature of the size and appearance of, for instance, a tiger, but with teeth able to graze, and intestines and stomach able to digest the food of an ox, such an animal would not be a tiger at all, but a nameless monster of whose existence there is no evidence.

Moreover, this theory requires us also to believe

that this grass-eating creature, and countless other herbivorous carnivores (!) were destroyed at the time of Adam's Fall, and their places supplied by a creation (after the sixth day, remember) of non-herbivorous carnivorous animals, or else that each of them underwent at once such a change of teeth, stomach, and intestines, as would really be the formation of new species, a transformation which neither Scripture nor Science claims to have taken place.

Compared with this, Darwinian Evolution is a trifle.

Verses 29 and 30 are remarkable for a departure from that purely objective literalism which needs no other explanation than the recognition of the facts asserted, to what may be styled subjective literalism. In the latter the reader needs to be placed *en rapport* with the one to whom the words were originally addressed, in order to obtain the meaning which the speaker intended to convey.

In the former case the proposition is literally true in itself, without reference to the subjective condition of either hearer or reader. Of this we have abundant illustration. "The Earth was without form and void, and darkness was upon the face of the deep," conveys a literal truth whether we understand it or not, whether the earth was a mass of unassorted earth and water shrouded in densest clouds waiting for the sun to be created, or whether it describes the period preceding the beginning of motion.

Of the style conveying what I have called subjective truth, we have abundant examples in the language of daily life, and need no other explanation than common sense at once supplies. "The house was crowded." "The farmer works all his life for a moderate competency." "The ground was all covered with snow." It is difficult to carry on a conversation without the frequent use of such expressions.

In this light read the twenty-ninth verse: "Behold I have given you every herb bearing seed which is upon the face of the whole earth," etc. Eden was to Adam "all the earth," of which he knew, and the qualifying or limiting word "the face," the face of the whole earth more particularly means all that Adam could see. As if God had said, "Look over all this land which I have given you, all its fruit-bearing trees bear food for you, all its animals are harmless, no beasts of prey among them."

This mode of speaking is so common in subsequent portions of the Bible, that it seems just to suppose the Author of the whole introduces at the close of this account this human mode of expression as an interlocking of the series of "logographs" with human thoughts, feelings, and forms of speech recorded in other portions of the written Word.

If such be the true character of the fauna of the Garden, there is no difficulty in reconciling the wide-spread belief that animals before the Fall

did not feed upon flesh, with the Geological fact that carnivorous creatures existed long before man appeared upon the earth.

CONJECTURES AS TO THE PHYSICAL FACTS UNDERLYING THE MOSAIC ACCOUNT OF THE CREATION OF ANIMALS.

For this discussion, three postulates are demanded.

The photographic truthfulness of the first two chapters of Genesis; the historical truth of the miracles recorded in both Testaments; the intimate relationship of organs and functions discovered by comparative anatomy between the fauna of to-day and that of earlier Geological Epochs. If the reader is not prepared to grant all these postulates, it will be a waste of time for him to read the remainder of this article.

Among the Scientific Theories, true or false, largely affecting men's minds at the present day, none is more prominent than that commonly styled Darwinism. Its influence, perhaps, is all the greater from the difficulty one finds in giving it a fixed form, a difficulty which enables it to adapt itself to every shade of belief, from the devout faith of the Christian to the boldest atheism, the one seeing in it clear proofs of God's being and power, the other, as evident proofs of the non-existence of any intelligence higher than man, or of any power other than the "laws of Nature."

I know of no reason why God could not have produced a world filled with organized creatures, on the plan of more or less frequent variation in successive generations, and the survival of the fittest, although it seems a very uncertain, complicated, and wasteful method. Nor, on the other hand, do I know of any reason why he should not have created a pair or more of each species, and impressed upon them and their descendants that stability of character which, at least in historical times, they certainly have possessed, however they may have come by it.

That the latter plan seems simpler, more certain, and less wasteful, is no proof of its being the actual method, for I admit that, if God pleased, he could have selected the worst possible mode of peopling his world, a mode which no man possessed of infinite power and wisdom would choose. Which one, then, of these methods was actually employed, becomes a question simply of evidence.

It is admitted that the formulæ for all species, as far as our experiments have extended, contain certain variable elements which admit of increase or diminution, and hence give rise to corresponding differences in their development. Perhaps this was part of the primal gift of dominion. How far this power extends can only be ascertained by exhaustive experiment. We can not only increase the normal amount of flesh upon our cattle, but by *judicious* breeding can impress upon their

descendants certain traits which we desire to perpetuate. We can produce one kind that most readily assimilate their food into flesh, another, into milk, and another, into great muscular power. Our horses can be so developed by careful, *intelligent* crossing, that one breed shall beget animals famed for speed, while another produces only those noted for powers of draught. By similar intelligent selection and propagation of like with like, we can increase or diminish certain peculiarities in our fowls, but as for those deeper elements on which is based our idea of species, no one has yet been able to touch them. Thus far at least, the evidence is *wholly* negative, and the fact that the slight variations which have been produced are due to careful and *intelligent* choice, not in the brutes, but in Man, is proof, as far as it goes, that if all animals are sprung from one stock, those deeper elements of being marking widely separated provinces of the animal kingdom, are due to a Cause of a similar but higher order.

Besides the present living animals, there are in the rocks the remains, in numbers absolutely incalculable, of pre-historic organisms, reaching back to the time life began. Very many thousands of species of these creatures, scattered widely over the earth, have been examined by men whose word is authority, and they tell us that thus far no affirmative evidence of a gradual change from one species

to another has been found.* The advocates of this Theory admit the correctness of this statement, but claim that somewhere evidence tending to establish its truth will yet be found.

It does seem a logical absurdity to rest so large a conclusion as Darwinism on so small a base of facts.

Beside the record of the Rocks, there is another that is for the most part ignored by the friends of this theory, or if they speak of it at all, do so in a tone of lofty superiority, as worthy of notice only as marking a wide-spread and lasting delusion from which the race is slowly awaking.

But an Author able to give with photographic accuracy the ante-human history of our globe, is certainly a witness whose evidence is not lightly to be rejected.

In the account in Genesis, three propositions are clearly set forth. 1st, That the "waters" and "the earth" "brought forth" fowl, water animals, cattle, and beasts, moving *living* creatures. 2d, That this "bringing forth" was due to no inherent power in the water or the ground, and that God claims creatorship or makership of all.† 3d, That these events occurred after the

* Darwin, Origin Species, p. 289, 1873.

† The Account says God *created* the water fauna and that he *made* the land fauna. What difference underlies this use of these two words, I am unable to say. The further advance of Science may at some future time explain it.

great climatic change which introduced varying seasons and unequal days and nights, and which, if my reasoning is correct, corresponds with the Glacial Epoch.

During that time of cold there was a very general destruction of living creatures, especially of "cattle and beasts" and other vertebrates,* yet subsequently, as we daily see about us, cattle, beasts, birds, and other vertebrates abounded. While these are all of species different from those that preceded the glaciers, yet they bear many marks of resemblance, so many that some Scientists think them accidental varieties.

Believing as I do that the miracles recorded in the Bible are veritable historical facts, I feel myself at liberty to use them so far as I see fit for the purposes of my argument. Nor can I admit the unscientific character of such use, as long as the very existence of physical science depends upon the truth of the propositions enunciated in the first Chapter of Genesis, itself a miracle.

From an examination of the miracles of the Old and New Testaments, we learn that it is God's habit, so to speak, to act, as far as the circumstances of the case permit, in accordance with the ordinary laws of nature, and to avail himself of the most closely related means and material, inter-

* Dana, Manual of Geol., p. 518, 1874. All the Fishes, Reptiles, Birds, and Mammals of the Tertiary, are extinct species.

fering divinely only at the moment of absolute need.

When Christ would furnish the marriage feast of his humble friends with wine, he did not command wine to appear, but he bade the servants themselves fill the jars with water, and draw out and bear to the guests. All this was done in the ordinary manner and in strict accordance with the laws of Nature. Christ only supplied what needed to be added to convert the water into "good wine."

When he fed the multitude, he used the materials at hand, the loaves and fishes, blessed and broke in the usual manner, and directed his disciples to distribute to the people, his power being applied to the one thing they could not do, viz. increasing the stock of food.

When God formed Eve, he did not create her from the dust of the earth; but he employed a method then and now in existence for other orders of beings, which naturalists call "fission." He took from the solitary Adam a part, a scion, or cutting, and from it he made (or built up) a woman. Here certainly is the positive testimony of an eye-witness whose veracity has stood every test, that, in the case of our race at least, there was, as to the female element, no Darwinian Evolution. The contradiction is absolute.

Turning to the Record of the Rocks, we find that in this Glacial period, all higher animal life

perished, and that consequently a repeopling of the world by the ordinary methods was impossible. The same Record tells us that land and sea abounded in the remains of the perished fauna, and, from the discoveries in the ice of Siberia, it is probable that numerous perfect bodies were preserved by the glacier itself.

In subsequent portions of the Bible we are told that the bodies of men shall hereafter be raised from the grave, by divine power, and be transformed as Spiritual bodies to a higher state of existence. Here facts fail me; beyond this I can only conjecture. But to what do these facts, few as they are, point?

The problem was to repeople the earth after the destruction of the Glacial period, and to do it, as far as possible, in harmony with God's usual laws.

As I interpret and coördinate the facts, this is their story.

Bleak, naked and silent after the long winter, the earth had within its bosom the yet living seeds and germs of the pre-glacial vegetation, which no degree of cold had been able to destroy, and which, under the vivifying influence of returning heat, clothed the land in verdure. "Everywhere, from beds of ancient glacial materials, vegetation was bursting forth and announcing itself." *

This would be in harmony with the ordinary

* Winchell, Sketches of Creation, p. 270.

laws of this great division of organic being. Seeds and germs retain their vitality by a power impressed upon them by the Creator, for a period to which, as yet, we do not know the limit.

In regard to ancient life, two courses were left open to the Divine Architect. He might start *de novo* with a new creation, or He might employ the means at hand, and cause the entombed bodies and the "dry bones" to live. It would seem more in accordance with God's sparing use of miraculous power that he should breathe life into the frames that lay prepared before him, than that he should create them anew, and then breathe life into them.

It is impossible to say *a priori*, which course was actually pursued, but turning to the words of our Eye-Witness, I find that the waters and the earth "brought forth" the new fauna, and I know there lay dormant or dead in the waters and the earth, myriads of the former fauna closely allied to those which have succeeded them.

These bodies or frames, then, may have been raised by Divine power, and, by God's plastic hand, may have been added or removed those parts and peculiarities which mark the difference between the species of to-day and those of an earlier period.

Hence the marvelous resemblances, the "reminiscent traces" of former stages of being, as well as the peculiar and infinitely wise adaptation of parts to the circumstances of being. The Master's hand makes itself seen in the variety as well

as the perfection of its work. It would seem as if every process of life was performed in as many ways as possible. When eating, man carries his food to his mouth by the hand; the fish, with neither neck nor arms, carries himself to his food. The elephant takes his, by reaching out his nose; the horse and tapir, by their upper lips; the fish-hawk holds his prey with his feet, while the crocodile drives his into his mouth by a blow of his tail. In all this variety, which extends into almost every process of life, there is such perfect harmony, such exquisite adaptation, that a naturalist can, from a single tooth, build up a description of the animal that carried it. Nor could any amount of reasoning convince him that a tooth which he had picked up in his rambles, belonged indifferently to a cow or to a tiger, or that it might have happened to grow in the mouth of a fish.

Moreover, such an origin, equally well with Darwinism, accounts for the relationships of fauna past and present, and for the persistence of types in the same locality from their first origin in remote geological periods, a persistence unbroken even by the great telluric catastrophe of the Glaciers.

As has already been said, the process of organic creation went on through all the "days" from the third, and ceased only after the creation of Eve, when God entered upon the rest of the Seventh day.

Whether, on the morrow of the day following this first Sabbath, or on any day subsequent, God

resumed his creative work, the Bible is silent. It is left to man to study on, and to discover if he can. One thing, however, is certain, if the Bible makes no assertion about it, their fears are groundless who dread Scientific inquiry.

It may be that my Scientific sight is not sufficiently clear, but to me such an origin as I have described, is infinitely freer from difficulties than that which traces man's descent from an ascidian, and that without supervising Intelligence.

I cannot reconcile my belief in an infinitely powerful and wise Being, with a plan slowly working up to perfection through an infinite series of chance results, the vast majority of which were either so imperfect as never to arrive at maturity, or if matured, unable to continue their kind.

Allusion was made, page 178, note, to some occult truth underlying the use of "create," v. 21, and "made," v. 25.

If my conjecture as to God's mode of producing the animals, be founded in fact, perhaps the more complete disintegration of the water fauna, rendered necessary a re-creation; while the almost perfect preservation of the land fauna whose remains may have been enclosed in the ice of the Glacial Epoch required comparatively so little, that the process was more appropriately described by the inferior word "made." The reader will at once recall the Siberian Elephant, whose remains were found in a state of perfect preservation near the mouth of the Lena.

PART III.

CONTAINING AN INQUIRY INTO

THE CAUSE AND EPOCH OF THE PRESENT INCLINATION OF THE EARTH'S AXIS.

TO WHICH IS ADDED

AN ESSAY ON COSMOLOGY.

INTRODUCTION.

THE work of the "fourth day," according to the Mosaic Account, was some change of the pre-existing order of things, which produced the vicissitudes of seasons, and the varying length of days and nights. The "lights" were to divide (the time) between the day and the night, were to be for signs and for seasons, for days and for years. What the physical truth underlying this statement was, we are left, as in case of other physical truths, to find out as best we may. The problem then is, how to read those verses in the light of present knowledge.

The more ancient opinion was, that the Sun, Moon, and Stars were created on the "fourth day," a belief which is sufficiently answered by the Account itself, which informs us that whatever it was that occurred, it took place not only after the creation of the "heaven," i. e. Sun, Moon, and Stars, but after the appearance of "grasses, herbs, and fruit trees."

A later, and perhaps at present, the most prevalent belief among those who accept the account as true, is that these bodies came into exist-

ence when God created the heavens and the earth, but had remained so obscured by dense clouds, as to be invisible; and that in obedience to the Divine command, on the "fourth day," the clouds and darkness cleared away. As to whether the earth had at that time days and nights of unequal length and changing seasons, and consequently the axis had its present inclination, this class of thinkers have not, as far as I am aware, expressed any opinion, apparently taking it for granted. I also notice that the most Scientific of them manage, in some way, to change the Mosaic order so as to place the appearance of the higher plants after the fourth day.

This explanation, certainly, has simplicity to recommend it, and once accounted for all the known conditions. But it is without foundation in the facts of our world's history, and has no better argument in its favor than that, if it were true, it met the exigency which caused its suggestion. Apart from the self-evident truth that one has no right to invent physical facts, the Geological record is such that the admission of this theory involves its supporters in inextricable difficulties.

Every one knows that such a vegetation as "grasses, herbs, and fruit trees," requires the direct actinic rays of the Sun for its growth and perfection. The dense, persistent layer of clouds, which such a theory demands, together with the warm, moist atmosphere, which we know prevailed

in the earlier history of our world, would have prevented the proper maturing and perfecting of such plants, and consequently the production of the seed. Hence, even had they been created under such conditions, they would speedily have died out, except by a continuous miracle.

Moreover, there are in the rocks the remains of myriads of animals that lived and died ages before "grasses, herbs, and fruit trees" made their appearance, and of course before the work of the fourth day. These creatures possessed eyes as perfect as are found to-day, a fact which forces us to believe that the animal and vegetable world then, as now, enjoyed the full light of the Sun.

For these, and for other reasons in reference to the distribution of animal and vegetable life, which will appear in due time, I felt compelled to lay aside this explanation as insufficient.

I began my search for an answer to the problem by a careful examination of the narrative itself. From its peculiar and careful wording, it was evident that the thing done, whatever it was, caused seasons, had to do with the measurement of the year, and the unequal division of day and night; I noted an absence of any allusion to months, the most ancient and most obvious division of time. Hence it follows, if the narrative states a physical truth, that the thing done on the Fourth Day, producing such effects, must have been a change in the inclination of the earth's axis, as nothing

else would affect both the "day and night," and the seasons.

At once I was met with the statement that, according to the most careful observations and the most refined analysis, no such change has ever taken place. But Astronomy observes only what is now occurring, and calculates the past and future state of our System, on the sole condition that the influences affecting it have always been and shall always remain the same in kind and intensity. On such conditions, it is easy to calculate the eclipses of the next century; but how if some immense meteor should dash the moon out of its orbit?

The question of possibility then resolves itself into this: has there been any difference in the intensity of any of the great forces of nature?

Astronomy, Geology, Optics, Correlation of Forces, answer at once in the affirmative, and bear witness that the power of heat in our System was once almost infinitely intensified.

The field is then open. No conclusions of Astronomical Observation or Mathematical Analysis, bar the entrance. The investigation has carried me far beyond the goal for which I started. It has gone out into the mechanism of the universe and brought solutions of many of its peculiarities and anomalies.

I find, however, questions which no action of unintelligent force can explain, and for which I

can see no other reason than the will of the Great Architect. Nor should this excite surprise, since it is no less true of the acts of ourselves and our fellows. A railroad is a formation evolved from rock and earth. Forces generated by the Sun, in the growth of vegetation, or in the evaporation of water, utilized by the muscles of men and beasts, heaped up the long embankment. All this can be readily shown, and one can get along thus far tolerably well without reference to anything higher. But why the embankment is of uniform width, and just wide enough for the trains to pass; why it reaches from city to city; why, with infinite labor, it tunnels mountains, instead of taking by "natural selection" the easiest and shortest route, are questions that can be answered only by assuming that kind of guidance which we call intelligence.

The work of the fourth period is placed by Moses after the completion of the Continents and the appearance of grasses, herbs, and "the tree bearing fruit the seed of which is in itself," and before the present living species of fish and fowl. If, therefore, the account be true, "not merely as to the facts asserted, but as to the order of their occurrence," the phenomenon which is described must have taken place in the interval, and if Nature and Genesis agree, *there* must be found the physical cause of the increase of the earth's axial inclination.

Geology reveals to us the interesting fact that *in this interval* between these biological epochs was the era of the Glaciers.

Geology also tells us that before the Tertiary (the era just before the Glaciers) a climate of wonderful uniformity prevailed over the entire globe, with "no zones of climate," and we all know that after the Glaciers there were and are seasons. Hence, during the Glacial epoch, according to this Witness, that axial change must have occurred.

In the present inclination of the Moon's orbit, and in the laws of organic life, I found a clew which led to the same result, viz. that down to the Glaciers, the axis of the earth was nearly perpendicular to the ecliptic, and that during this period of ice and cold, its inclination increased to its present angle of 23½°.

It then remained to search for the physical cause of this movement, which was done by an exhaustive examination of all possible influences affecting our planet. This independent line of investigation also placed this important event in the era of the Glaciers, thus corroborating my former conclusion.

It certainly is very remarkable that four lines of proof, so different from each other in every respect, and so entirely independent, should lead to this same result.

The mode of study and investigation pursued was this:

I first found that anterior to the historic period there was a time when the earth's axis did not have its present inclination; that it was normally perpendicular to the ecliptic; that at the moment of lunar segregation it was inclined about 5° 9′. I then examined the facts revealed by Geology as to the distribution of ancient vegetable and animal life, with special reference to any indications of change of axial inclination, and as to its biological date.

Having shown the occurrence of such a change, and fixed its epoch, I sought a sufficient cause for it, which I found in circumpolar upheavals.

This led to the discussion of the effects of such massive movements, and suggested the thought that in such might be found the solution of many of the problems of our Cosmos.

I found that the same physical cause had operated throughout our System, and that the obliquities of the axes, the eccentricities and inclinations of the orbits of its members, as well as their annual revolutions and unequal times of rotation, are the legitimate results of one great law and the necessary consequences of its once nebulous condition.

In this discussion, as elsewhere, I have drawn largely on Dana's Manual of Geology, not for its theories, however admirable, but for its facts as data on which to found or strengthen my arguments.

I find nothing elsewhere to contradict any of the statements quoted from that work, save possibly as to the present non-existence of any ante-Glacial species of "fish, reptile, bird or mammal." In general, the statement is true, and most probably so in its broadest sense. The surviving pre-Glacial species belong to the lower orders.

With these explanations, I submit my thoughts on these subjects to those whose matured verdict shall decide whether I have followed a veritable Angel of light or a miserable will-o'-the-wisp.*

* I have just received Dana's New Edition of his Manual. On comparing the portions to which I have referred, I find little to change. I have altered my references to correspond to its paging.

INCLINATION OF THE EARTH'S AXIS.

SECTION I.

FROM the most remote historical period to the present day, the same alternation of seasons, and the same inequalities in the length of the days and nights, have prevailed, and from this we know, positively, that during this time the Inclination of the Earth's Axis, their cause, has not materially changed. It now amounts to nearly $23\frac{1}{2}°$. Was it always of just this size, or was it once different? If different, when did the change occur, and what was its cause?

That the present condition is not eternal, is evident, since at the time the Earth was an integral portion of the Cosmic Nebula, it had no individual existence, and consequently, no axis. Nor could it properly be said to have one, even after its avulsion as a ring, from the parent mass. An axis, in the sense we are considering, was possible only after the "ring" had been gathered into the spheroidal body which constituted the embryo planet. If that was allowed to take position in

obedience to the laws of gravitation and motion, undisturbed by other forces, its axis was necessarily perpendicular to the plane of its orbit.

For an unknown, but doubtless very long period after this aggregation, the Earth and Moon formed one Spheroidal body, having, of course, but one axis, which they retained up to and for a longer or shorter time after the latter's avulsion.

The orbit of the Moon normally was in the plane of the Earth's equator, and hence, if not disdisturbed, the present inclination of its orbit must reveal the inclination of the Earth's axis at that time; in other words, their axes were then parallel.

At the present day the axis of the first is inclined 5° 9′ to the ecliptic, while that of the Earth is bent from the perpendicular 23½°. A separation of these axes amounting to about 18½°, has, therefore, occurred since the formation of our Satellite, which must have been due to a movement of the Moon alone, or of the Earth alone, or to both.

It will be found, if I am not mistaken, that this difference (18½°) is almost wholly due to an actual change of position by the Earth, and in a very small degree to a movement of the lunar orbit.

That the lunar orbit has undergone a less change of inclination than the Earth's axis, is extremely probable, for the reason that it is now 18½° nearer the normal position than the latter. Indeed, La Grange's celebrated Theorem would seem to render it certain that the change was

wholly a change of the Earth's axis, for he has shown that all the forces *now affecting* the planets or their satellites, act within certain limits, alternately increasing and diminishing, but making no change in the mean inclinations of their orbits. According to that, the orbit of the Moon to-day has precisely the same inclination that it had at the first moment of separate existence, and since the axes then were parallel, the present difference is wholly due to the Earth. I shall, however, so far anticipate conclusions reached hereafter, as now to say that this does not by any means exhaust the subject, but that the total result of all forces now or ever affecting the Moon, has produced a comparatively small but permanent change of the inclination of its orbit, although nearly all of the $18\frac{1}{2}°$ was due to an increase of the Earth's inclination.

The reader will therefore bear in mind that an increase of inclination amounting to the whole of the present difference between these axes, has actually occurred at some time since the formation of the Moon, and before the earliest historical records. This was not an oscillation, but a permanent change, a fact which utterly destroys the almost superstitious belief in the immobility of these axes, which is commonly entertained.

It must, therefore, be *borne distinctly* in mind that the question, which we are about to discuss, is not as to the occurrence of an axial change since the separation of the Moon from the Earth, but whether it occurred before or after the nebu-

lous mass had become solid; if after solidification, whether before or after the appearance of organic life; and if the latter, at what Epoch did it take place?

From the segregation of the Moon to the appearance of life, there are no facts known to me having any bearing on the subject; we must seek to arrive at the truth by a more circuitous route. If it could be shown that during the earlier Geologic Periods there was the condition necessarily produced by an axis nearly perpendicular, in the then warm climate, we should know that the increase of axial inclination had not previously occurred. This line of inquiry is open to us.

Geology has furnished a tolerably complete record of the ante-human races of plants and animals which have flourished upon our globe. In this, if I mistake not, are found facts that not only are in accord with the reality of an increase of the inclination of the earth's axis, but fix within certain limits the date of its occurrence.

Thanks to the labors of modern Scientists, and eminently to those who style themselves Evolutionists, the Uniformity of Law is so well established that entire confidence may be placed in conclusions based upon it. We are therefore justified in assuming that in the earlier ages of the world, as now, the essential conditions of life, apart from food, were light and heat.

The relation of life to the amount and distribution of light, is of the most intimate character,

and as these depend so largely upon the inclination of the earth's axis, it is reasonable to expect to find in the fossils of polar regions, indications which shall be of great importance in the solution of the question under consideration.

In Dana's Manual of Geology, p. 181 (1874), we are told that "no marked difference between the life of the Primordial Rocks in warm or cold climates, has been observed." "The eyes of Trilobites indicate that there was the full light of day." (p. 209.) "No proof that a diversity of Zones of Climate prevailed over the globe in any portion of the Lower Silurian Era, as far as yet studied." "Seven or eight United States and European Species are found flourishing in tropical profusion on the east and west shores of Boothia and Fury Point, on North Somerset." At the close of the Upper Silurian, "the living species in the waters between 30° and 45° were in part the same, or closely allied in species, with those that flourished between 65° and 80°." (p. 253.)

In the Carboniferous Period we find coal-beds on Melville and Bathurst Islands, and Bank's Land. (p. 352.) "Corals common to Europe and United States are found in lat. 70°, others have been found in latitudes from 75° to 77°." (Idem.) "The coal-beds of the Arctic are evidences of a profuse growth of vegetation. The plants were not mosses of peat-swamps, such as now extend far north. Through the whole hemisphere, and we may say, world, *there was one uniform type*

of vegetation, and there were genial waters for Corals and Brachiopods. The *conditions between 70° and 78° were analogous to those of the* United States from Illinois to Texas." Reptiles of the Middle Mesozoic are found in lat. 77° 16′ N., and there is no reason to believe that the plants in Melville differed essentially from those in Pennsylvania or in Texas.

The italics in the above are mine.

These facts, in reference to which other authorities agree, might be extended indefinitely, but enough has been quoted to prove that "the same flora and fauna flourished abundantly" from well towards the tropics to lat. 78° or 80°, and that thus far the conditions of life at those extremes must have been substantially the same.

The importance of light, as a condition of vigorous life, is well known. Even Corals will die, if sunk too far below the surface of the water,*

* I am aware that it is usually thought that Corals die below a certain depth from decrease of temperature, and there can be no question of the fatal effect of too little heat upon these tiny creatures, but the experiment recorded below, certainly points clearly to the great influence of light upon the lower orders of animals. It is well known that light is necessary to the health and well-being of higher organizations, especially if its absence is not accompanied by cold.

The fact remains that Corals do die, when sunk below 300 feet, a depth sufficient to greatly reduce the supply of light. Experiments as to this influence are yet a desideratum.

In Appletons' Journal, p. 110, 1870, I find the following:

and plants will sicken and perish if deprived of this necessary stimulant.

Wm. Edwards placed in a box twelve tadpoles, near the usual epoch of their transformation into frogs, and weighed them, and then plunged the box into the water of the Seine, at Paris. A greater number of the same lot of tadpoles were placed in a large vase, the water of which was changed daily, and in which they were fully exposed to the light and could come to breathe at the surface. These were in a few days transformed into frogs, while only two of the other twelve underwent this change, and not till long afterwards. In the comparative darkness of the deep water, ten of them remained in their larval state, after they had doubled or tripled in weight.

The above was written before I had an opportunity of examining Dana's "Corals and Coral Islands," where I found, page 118, the following statement. Its bearing upon my argument is obvious:

"As to the origin of this small range in depth—about 120 feet—temperature must be admitted as a cause. Yet it can hardly, in this case, be the only cause. The range of temperature, 85° to 74°, gives sufficient heat for the development of the greater part of reef species, yet the temperature at the 100 feet plane, in the Middle Pacific, is mostly above 74°."

So it is not lack of warmth that kills these creatures, nor is it any impurity in the water, for certainly the impurities do not undergo any such corresponding increase of intensity. The pressure of the water is not an element affecting creatures that are composed of tissues filled with water, and not with air. The only conceivable variable element capable of producing any effect, is the light.

Nor is it an objection to this view that the Corals are destitute of organs of sight, for in no case is the health or vigor affected through the eyes of any creature, and plants whose sensibility is marvelous, are as destitute of such organs as the Corals.

The effect of light, or its absence, upon plants, is a matter of daily observation, and it is a rare thing for one to do equally well in the shade and in the direct rays of the Sun. If it be kept in the dark, but warm and moist, a pale, sickly growth ensues, with an absence of power to produce and mature seed. Indeed, death follows if the absence of light be sufficiently prolonged.

If the Axis of our Earth had, in those ages, its present obliquity, there must have been the corresponding inequality of days and nights, an inequality giving, in the highest latitudes where fossils have been found, a day, in summer, of four months' duration, followed, in winter, by a night of equal length. Hence, if there be any truth in Uniformity of Law, it is impossible that the same plants "flourished luxuriantly" under the almost equal days and nights of Texas, and the four months' day and night of lat. 78°.

The condition of temperature is one that cannot be ignored. If the earth's axis had been inclined as now, 23½°, the *uniform* temperature which prevailed * would have been impossible. The short nights of India suffice, by radiation and evaporation, to produce ice in sufficient quantities to be an article of traffic. How greatly would the effect be increased if the night continued four

* A great preponderance of ferns and lycopodiums indicates moisture, *equability* of temperature, and freedom from frost. (Lyell, Man. Geol., p. 395.)

months instead of about twelve hours! Radiation so long continued (remember, the polar climate was then *warm and moist*) would result in the destruction of all tropical animals.

If to this it be said that excessive radiation was prevented by a covering of clouds, I answer that the character of the vegetation, at least towards the close of the Tertiary, forbids it, for at that time, in lat. 79°, were found Hazel, Poplar, Beech, etc. (Dana, 1874, p. 315.) "A vigorous growth," Lyell says. Such a flora cannot admit a darkened sky, nor a long night, warm and moist.

But it may be said that the warmth of those polar regions was due not merely to the Sun, but in a much greater degree to warm currents of water, to low lands of moderate extent, and more or less to internal heat, and therefore they were not likely to be so much affected by radiation during the absence of the Sun. And this is undoubtedly true; but unless the internal heat was so great that life at the tropics would have been impossible, it cannot be that these causes combined could give, during the long polar nights, a climate anywhere near the same as that which prevailed in the same regions under the continued heat of a polar day. For, calling the total heat from these sources A, and the additional heat of the Sun B (no small quantity now, as navigators tell us), there must certainly have been a difference between the temperature of the day and that of the

night, equal to the latter quantity, a variation of many degrees and sufficient to destroy any possibility of "equability."

Moreover, the "habit" of the carboniferous plants was peculiarly favorable for the cold that came from evaporation and radiation, to produce its full effect. For they did not grow in great masses of water, as the Algæ, nor on dry land, but in moist places, where the widely spread but shallow water was eminently fitted to aid in the process of refrigeration.

It is said that Arctic plants are found on the tops of high mountains, where, although they have Arctic cold, they are also exposed to days and nights of comparatively equal length, and that they flourish there as well as in northern latitudes with their long winter nights.

Admitting the identity of the species, which is questionable,* still the cases are not analogous. The Arctic plants, accustomed to a stagnation of six to nine months' duration, may well be indifferent as to where that time is spent, whether in the cold and darkness of an Arctic night, or the cold and light of a lower latitude. But the plants of the Carboniferous Age were not polar plants at all, but tropical, nor were they accustomed to a

* Darwin, Origin of Species, p. 338, says, "It should, however, be observed that these plants are not strictly Arctic forms; for, as Mr. H. C. Watson has remarked, 'in receding from polar towards equatorial latitudes, the Alpine or Mountain floras really become less and less Arctic.'"

sleep of six or nine months, nor at that remote period was there any Arctic cold to produce hibernation, but a "warm, moist, equable atmosphere," in which they "flourished luxuriantly."

Mutatis mutandis, the same remarks apply to the few plants of the temperate zone that have straggled to the far north (Smith's Sound), whose dwarfed and scanty growth is in marked contrast to the luxuriant growth of the coal-forming period. In like manner stand in sharp opposition the vigorous growth on Spitzbergen, of which I have spoken, and the dwarfed willows that are to-day their successors.*

* To the argument from Uniformity of Law, and the Conditions of Life, I find Lyell, in his Principles of Geology, page 88, making answer thus:

"The range of intensity of light to which living plants can accommodate themselves, is far wider than that of heat. Palms have grown in hot-houses at lat. 60° N., having extremes of 19 hours light to only 5 hours."

REPLY. The cases are far from analogous. Is there any evidence that Palms could "flourish luxuriantly" and mature their seed "in a warm, moist, equable atmosphere," shut four months from the action of sunlight, and then endure its uninterrupted power for an equal time? By the way, do they mature at 60° N. lat.? On page 89, he says, "we should expect that in lat. 65° at least, where they would never remain twenty-four hours without sunlight, they *might still exist*." Quite possibly; but surely this is quite different from four months' night, and "*flourishing luxuriantly*."

"Tree ferns grow in the gloomiest and darkest part of the forests of warm and temperate regions."

All writers on Geology admit the non-existence of "Zones of Climate," in these remote pe-

REPLY. The conditions are not sufficiently alike to permit any analogy. Diffused daylight is very different from a warm, moist, equable night of four months' duration, followed by an uninterrupted day of equal length.

"The coal plants were of perfectly distinct species (from living ones); nay, few of them, except ferns and pines, can be referred to genera, or even families of the existing vegetable kingdom. . . . They may have been endowed with a different constitution, enabling them to bear greater variations of circumstances in regard to light."

REPLY. Although so many of the coal plants were different from modern kinds, yet it would be contrary to all our ideas of plant character being affected, and I may say determined, by its surroundings, that a flora so identical could have been developed under the widely different conditions in which we find these plants. Moreover, the ferns and other vegetable productions of that period, seem to have been specially fitted for the large and rapid disposal of the superabundant carbonic acid which then existed, constituting, as it were, an atmospheric fertilizer which would, in "the warm, moist, equable atmosphere" of those regions, have stimulated growth in the long nights. This, as we see now in case of vegetables kept in a "warm, moist, equable" but dark cellar, would result in an abnormal development unfitted for all plant purposes.

But even if experiment should establish the possibility of ferns and other species of the lower orders of the vegetable kingdom "flourishing luxuriantly" in such conditions, it is too much to ask us to believe that the same would be true of the higher orders. The "vigorous growth of trees, as the Poplar, Alder, Beech, Plane, etc.," in lat. 79°, a growth which Lyell styles remarkable, occurred cotemporaneously with the Common Cypress of the Southern States. The vigorous growth in Spitzbergen of Poplar, Alder, Beech, etc., of which

riods. The evidence is equally strong, in fact, identically the same, that there were no Zones of Light.

From the conditions, therefore, of light and heat, and the universal prevalence of identical

mention has been made, was accompanied by the common Cypress of the Southern States. (Dr. Gray.) There were two species of Lybocedrus in the Spitzbergen Miocene (Heer), and one now lives with the Redwoods of California, while the other occurs in the Andes of Chili. (Dana, Man., p. 526.) These indicate a climate very happily illustrated by the last-mentioned tree, a climate without extremes of cold or heat, "equable and mild," and in such a climate an entire flora of nearly 100 species could not have had a remarkably vigorous growth in circumstances so different from their present habit, as is indicated by four months of darkness.

If to these positive facts we add that there is no proof of "the difference of constitution" which Lyell suggests, other than the exigencies of the argument, I think we may safely dismiss it from further consideration.

If to this it be replied that Willows, "stunted and dwarfed," do actually grow in those same northern regions at the present day, notwithstanding the long nights, I reply that this ability to survive the present winter is no evidence that they could have "flourished vigorously" there when the entire year was warm. As has been said in reference to Arctic plants (or species resembling them) growing on the cold tops of tropical mountains, a plant that is exposed to sufficient cold to cause hibernation, may well be indifferent whether that period of torpor is passed in cold and continued darkness, or in cold with the tropical alternation of days and nights of tolerably uniform length.

Lyell's difficulty lies in the assumption that an increase of the Earth's axial inclination is absolutely inadmissible. But the astronomical argument proves not only its possibility, but its actual occurrence. The only remaining question is as to the epoch at which it took place.

species, I am compelled to believe, unless "Uniformity of Law" is a delusion, that down to the end of the Mesozoic, perhaps to the Pliocene, the axis of the earth had not changed from its inclination at the epoch of its avulsion from the Moon, and consequently was nearly perpendicular to the ecliptic, a conclusion which fully accords with my previous assertion that the present difference, (nearly $18\frac{1}{2}°$) between the inclination of the Moon's orbit and the Earth's equator (or between their axes) is principally due to a movement of the Earth itself. This we shall find confirmed hereafter by another and entirely independent line of argument.

From this time to the Glaciers, I see no evidence of Zones of light. The fauna and flora towards the end of the Tertiary, indicate a lower temperature, but nothing to indicate a variation in respect to light from previous conditions. It is true the earth was growing colder. The isothermal lines were gradually falling towards the equator, but this apart from evidence of polar nights and consequent vicissitudes of seasons.

This reduction of temperature was the result, in part, of loss of internal heat, in part of an increase of polar lands, and a change in direction of polar currents.

Such a decrease of temperature in the higher latitudes, accords also with the fact that the Sun's greatest altitude, at that time, in regions outside

of the present tropics, was 18½° less than it is now. In the latitude of New York, the Sun then rose, in midsummer, only to the height it now attains in the north of Labrador, and at London it rose only as high as it now does at North Cape. In other words, the Sun rose at midsummer to no greater height than it now attains in the first week of April.

There are few indications of what occurred during the Glacial Period. It has no fauna nor flora, to write its history in hieratic characters. Its page is almost blank; a few rude scratches, and many confused blots of debris, are almost all. But after its close, as life and verdure again, as on a resurrection morning, clothed the earth, we find, for the first time, unmistakable signs of changing seasons, and, consequently, days and nights of unequal length. Hence the Epoch of this great event, the increase of the inclination of the earth's axis is here, in this winter of our globe. It lies between the culmination of the vegetable kingdom and the completion of continental emergence on the one hand, and the development or appearance of the post-glacial fauna on the other, a fauna which, by all analogy, should resemble that of present circumpolar regions, the full development of fowl and water animals of the present day. In other words, the date of this event is to be found between the grasses and fruit trees of the last period of continental preparation, and the living species of water and land animals.

SECTION II.

It now remains to seek for a Cause for the Increase of our Earth's Axial Inclination.

I shall attempt this, by an examination of all forces possibly affecting our Globe. As far as I can discover, there are only five.

1. A Miraculous Interposition.
2. The Magnetic Influence of the Sun.
3. Collisions with Meteors.
4. Centrifugal force generated by the upheaval or depression of portions of the Globe.
5. The attraction the Sun, Moon, and Planets on such upheavals.

I dismiss as unworthy of serious consideration the unphilosophical and unscientific idea that somehow, without cause, the world in the process of formation from a Nebula, got a cant to one side. Yet this is the unexpressed belief of a large number of men, otherwise scientific.

A MIRACULOUS INTERPOSITION.

The incalculable importance of the inclination of the earth's axis, together with an inability to assign any physical cause for it, has induced many persons to refer it to the special interference of the Creator, by which they mean, not God acting through his laws, but outside of, or even contrary to his usual mode of action, and, as is implied in the word *special*, something peculiar to our planet.

But any explanation based upon the belief that this condition of axial inclination is peculiar to our Earth, is seen to be untenable as soon as our view extends beyond our planet, and we learn that every member of the Solar System revolves about an axis more or less oblique; and not only that, but that the axis of each orbit is also bent from the perpendicular.

Moreover, the "final cause" of such an interference, viz. that the inhabitants of the planet may enjoy the benefits arising from changing seasons, however much it may have affected the Divine mind in the case of our Earth, certainly is not applicable to the others.

Jupiter's axis is too little inclined to produce any sensible effect. That of Venus is so oblique that the same spot is alternately exposed for months to the unendurable heat of a torrid Sun, which during that time never sets, and an Arctic winter, where for an equal time the Sun never rises. The Sun, where seasons are impossible, has an axial obliquity more than twice as great as that of Jupiter, while, to crown it all, Uranus has its axis inclined 20° more than is needed to give it the very seasons it now enjoys. In addition to all these, to say nothing of the position of the axis of our Moon, there are the varying inclinations of the orbital axes, which have no relation whatever to days or seasons.

The fact then that the axis of every member

of the Solar System and of every orbit is bent from the perpendicular, clearly indicates the action of some general law implanted in the constitution of the Cosmos. While the variety in the effects produced, proves that it acted on each separately, that is to say, after its segregation from the original nebula, the individuality of character imparted, reveals the existence of some coöperating local force.

I am therefore compelled to conclude that the solution of this problem is not to be found in a Miraculous Interposition.

THE MAGNETIC INFLUENCE OF THE SUN.

The Sun, as is well known, has a magnetic influence, since the needle responds to certain phenomena in that body.

Is the present position of the Earth's axis a residual of some former state of greater magnetic power?

Omitting all reference to the fact that such a condition is purely hypothetical, I find reasons to reject the proposed solution of the problem in the laws of Magnetic action.

When a large magnet is held at some distance from another which is free to move, the latter at once assumes a position parallel to it and follows every change of its position. Consequently, if this power had affected the earth and other planets, their axes must have been at that time parallel to

the Sun's, and they should even now retain the same degree of obliquity, a result so contrary to the present facts that the only conclusion possible is that the Magnetic Influence of the Sun is not the force we seek.

To this it may be added that such an explanation, if true, would leave the inclinations of the orbits unaccounted for.

THE EFFECTS OF METEORS.

In the opinion of some, the collision of meteors with the planets has played an important part in the formation and arrangement of the Solar System.

A collision with a meteor of sufficient size would undoubtedly affect the inclination of the planet's axis, as well as that of its orbit, and would increase or diminish the latter's eccentricity. But as meteors are extra-Cosmical bodies, coming from every part of the Universe, the probability of their producing as their resultant, any great effect, is infinitely small, since a blow in one direction would sooner or later be neutralized by one in the opposite.

Moreover, any such collision on a great scale upon the earth, since life appeared, would have left unmistakable evidence of its action. And if to this it be said the present condition is the result of an infinite number of small collisions, the difficulty is increased, for that would render it

necessary to show a preponderance of blows in one direction for an infinite number of years.

The difficulties are too great, the hypotheses too many, for the acceptance of a theory having so small a foundation in facts.*

CENTRIFUGAL FORCES.

If our earth were a perfect sphere, and a portion had been so upheaved as to project beyond the surface, it follows from the laws of motion that the centrifugal force generated by this mass, as it revolved about the axis of the sphere, would not be neutralized, but would be a free force; and it has been said that this, exerted long enough, would give any required inclination to the axis. This force I now propose to examine.

Let Fig. 1 represent a homogeneous sphere revolving freely on its axis AA′, in the direction of the arrow-head, and let M be a heavy mass, small in proportion to the sphere, fixed upon and projecting from the surface at a sensible distance from the pole.

The centrifugal force generated by M will cause it to recede from the pole; but as the sphere revolves, M moves to the left, and still drawing away from the pole, there results a movement towards N and again at M″ towards N′. In other

* It may be true that meteors have more or less to do with the varying masses of the planets, but this lies outside of my present inquiry.

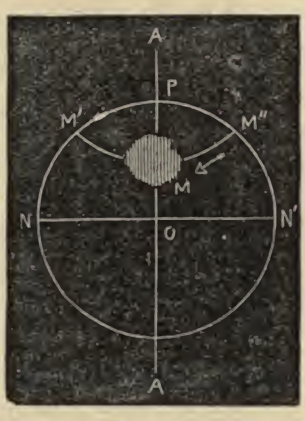

FIGURE 1.

words, there arises a movement from A on every side towards the equator, which can only occur by M apparently sliding at each revolution a little farther down the great circle PMO until it arrives at the equator, when the longest diameter (that passing through M) will be perpendicular to the axis, and the system again in equilibrium. Of course M, being fixed upon the sphere, causes it to move in the same sense.

From this it follows that the latitude of M has changed, while the axis of the sphere has remained parallel to itself.

If, instead of a mass added to the sphere, a portion had been removed, forming a depression, a precisely similar result would have followed, but in a contrary sense.

A mass equal to M, placed at the opposite extremity of a diameter passing through it, would double its effect, while an equal depression at that point, would neutralize it. And in general, if the great circle passing through M be divided into quadrants, calling that in which M is 1, and numbering to the right, the effect of M will be increased by a protuberant mass in 1 or 3, and diminished by one in 2 or 4; while a depression would produce the opposite result.

From all of which it follows that no possible combination of elevations and depressions can, by their centrifugal force, produce any effect upon the direction of the axis of the earth.*

* It may prove interesting to verify this truth by actual experiment. For this a simple modification of the Gyroscope may be used. Procure a ball of hard wood some five inches in diameter, with an axis of wire projecting an inch or so at each pole. Procure also a scale-beam of light wood, of the same length as the axis. Suspend this in the usual manner by a light cord, taking care that the beam shall be so adjusted that when loaded the centre of gravity and point of support shall coincide. At the extremities attach equal strings with loops of wire in which may rest the extremities of the axis of the sphere.

This apparatus will possess great freedom of motion, and at the same time the sphere will remain at rest in any position, being in all respects in a state of indifferent equilibrium. When set to revolving, it will exhibit the usual phenomena of the Gyroscope.

A piece of lead may then be fixed with a screw upon the surface at, say, 45° from the equator, and another of equal size and weight at the opposite end of the diameter, pass-

The fact that the earth is not a sphere, but an oblate spheroid, presents no real change of condition. For it may be considered a sphere with an equatorial protuberance completely belting it.

In this case, as M recedes from A, the portion of the belt below it will recede an equal distance from the equator, while on the opposite side the protuberance will rise above it, and these being in reference to M, in quadrants 2 and 4, will tend to neutralize its effect, the one increasing and the other diminishing as M approaches the equator, until the system is again in equilibrium.

Hence, in an oblate spheroid, as well as in a sphere, it would be possible to make the latitude of places vary indefinitely, but no combination of elevations or depressions could, by their centrifugal forces, affect the position of the axis.

If, in the last case, M were removed, the pro-

ing through the first. The system will still be in equilibrium.

If, now, the sphere be made to revolve with moderate rapidity, it will rotate, not around the original axis, but around one nearly parallel to its normal position, while the former (the original axis) will revolve with the sphere, the projecting end describing a circle about the new pole. The lack of absolute parallelism is due to the difficulty of starting the instrument without disturbing its position, as well as to its having to move a mass outside of itself which is not symmetrically placed.

tuberant belt would return to the equator, and every place resume its former latitude.*

From all these considerations I am brought to the conclusion that the power which affected the position of our planet's axis, does not lie in Centrifugal Forces.

The only conceivable force remaining is

THE ATTRACTION OF THE SUN, MOON, AND PLANETS ON MASSES ELEVATED ABOVE THE TRUE SURFACE OF THE EARTH.

For the purposes of this and similar discussions, the earth may be considered, without error, as a motionless body placed at the extremity of a rigid radius of its orbit, but able to move with absolute freedom about its own centre. For, the forces under consideration, i. e. the attraction of the Sun, etc., being at right angles to the diurnal and orbital movements, will produce the same effect upon the planet as if those movements had not been in existence. A body driven east with a velocity of five miles an hour, and impinged upon by another force capable of sending it south at the rate of seven miles in the same time, will,

* I have not thought it necessary for my purpose to distinguish between the direct centrifugal force of M, and what I may term its "turning power," into which it can easily be resolved. The former increases as the cosine of the latitude, while the latter increases as the sin lat. x cos lat., and is therefore zero at the pole, increases to 45°, and again becomes zero at the equator.

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it is true, describe the resultant of both forces, but it is equally true that it will go exactly as far south as if the east force had not been applied.

In brief, each force performs its work as if it was the only one acting.

Omitting, therefore, all consideration of orbital or axial motion, we shall suppose the earth a homogeneous *sphere* placed 91,500,000 miles from the Sun, but free to move in any manner about its centre of gravity.

It is evident that the solar attraction can not produce any movement, since its influence upon one part is counterbalanced by another symmetrically placed.

If the axis is perpendicular to the ecliptic, the attraction of the Sun upon a polar upheaval will be equally without effect, since no internal movement can change the position of the centre of gravity (Principia), and a polar upheaval would necessitate a sufficient movement of the remaining mass in the opposite direction, to keep the equilibrium undisturbed, while the intensity of the attracting force on each molecule would be unchanged.

But if the axis were sensibly inclined, say 5° 9′, and the sphere elongated in the same direction (i. e. a polar upheaval), then one pole would be nearer the centre of attraction than the other, and acted upon with greater intensity. Hence it would be drawn towards the ecliptic precisely in

the same manner and for the same reason as is now the equatorial protuberance.

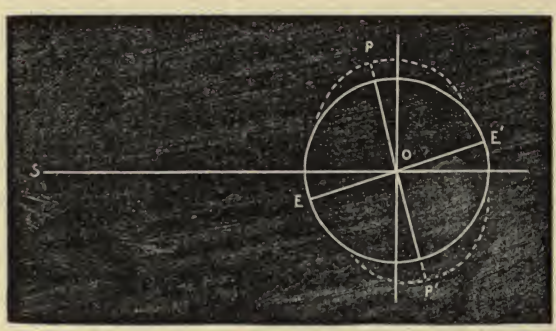


FIGURE 2.

Let Fig. 2 represent a homogeneous sphere, with axis PP' inclined to the ecliptic, S being the Sun. Suppose the sphere to be elongated, as represented by the dotted lines. Then, since P is nearer the Sun than P', it will be attracted more strongly, and consequently drawn down to the ecliptic, and if no force opposes, its momentum will carry it as far below, until stopped by the action of S, when it will return to the ecliptic, and so vibrate back and forth like a pendulum.

An equatorial protuberance, for similar reasons, would be an opposing force, which being null when the equator coincides with the ecliptic, increases as the ang. SOE increases, until, becoming equal to the turning force exerted by

P and P', the system again comes into equilibrium.*

From this it appears that three conditions are necessary to give a homogeneous sphere the position occupied by our earth.

1st. That the axis should already be sensibly inclined.

2d. That there should be a polar upheaval.

3d. That there should be an equatorial protuberance.

The part which each of these performs has already been sufficiently indicated. It is in evidence that the earth's axis once had an inclination

* It may, however, be thought that the revolution of the earth upon its axis somehow imparts such stability to it that a polar attraction would produce no effect.

The same little instrument described on page 216, note, will be useful as illustrating the truth of the statement which I have endeavored to establish.

From the sphere, remove the lead weights used in the experiment described a few pages back. We then have a modification of the common gyroscope. Turn the instrument to the right or left, to give the supporting string some slight degree of torsion. Then set the sphere in rapid rotation on its axis, and allow it freedom of motion. It will invariably be found (if the experiment is performed with reasonable care not to impart lateral or circular motion by the hand at the moment of ceasing to hold the instrument) that the exceedingly slight force exerted by the tension of the string, acting as it does, perpendicularly to the axis at each pole, will cause the sphere, while revolving rapidly on its horizontal axis, to also revolve slowly about a vertical one. Q. E. D.

of about 5° 9′, while its present oblateness leaves no question as to the fulfilment of the third condition.

It remains then, only to consider the second, and also whether any possible upheaval could have been large enough to overcome the stability of the equatorial belt.

As to the existence of *polar* upheavals. There is scattered everywhere over the Geologic page evidence in abundance that immense upheavals and corresponding depressions have been frequent in the history of the globe, from the earliest periods to the present moment.

In general, these occurred indifferently in every portion of the globe, and were not of the polar character required. But the Glacial Period, towards which so much independent testimony points as the epoch of this great movement, was peculiar for its enormous northern and southern upheavals. These not only gave the kind of upheavals for which we are seeking, but at the same time, by the necessary, corresponding equatorial depression, by so much diminished the resisting power of the equatorial belt.

The vast extent of these polar upheavals is plainly indicated by the large area of country over which the ice of the Glacial Period has left its traces, an area extending from the poles at least 50° towards the equator. As to the height of the movement, or even the thickness of the ice then

formed, there are no data on which to form any exact estimate. That it must have been considerable is shown by the fact that stones frozen fast in its under surface were pushed over the tops of most of the mountains in the New England and Middle States, as proved by their traces or striæ graved on the surface rocks.*

* In estimating the area of this ice-cap, it must be borne in mind that while the striæ are proof of the former presence of a glacier, the opposite is by no means true. The striæ and the debris are evidence of ice in motion, and they also reveal the direction of the movement. If from any cause the under surface was at rest, all these indications would be absent. It is quite possible to imagine an immense extent of country covered with a great depth of ice and snow, which should leave none of the characteristic marks of glaciers.

Suppose a plain some thousands of miles in diameter, covered with a moderately thick layer of ice. The edge of this ice might even be vertical; but as the height increased, as layer after layer was applied one above the other, there would at length be a pushing out of the lower portion and a dropping down of the "shoulder" of the ice until a point was reached when the rigidity of the ice itself and the friction should become equal to the moving force. This movement would extend into the great mass to a distance depending upon the height, i. e. the pressure, but in no case could it reach inward farther than the point vertically under the shoulder; in fact, it could not reach as far as that. All inside of this point would be at rest, and consequently all the immense area within such points would be at rest, and hence, for many millions of square miles so covered, there would be neither striæ nor debris. If the surface of the plain abounded in inequalities, or if it was bounded by a rim of

The absence of marks of great convulsions is further evidence that this upheaval was due to no local action, but rather that it was a telluric oscillation, too vast to exhibit the ordinary results in contorted strata. Such immense lines admitted of flexure under sufficient force acting with infinitesimal velocity.

high lands, the needed depth of ice to produce motion would be greater, and the area of no motion larger.

I can imagine a polar ice-cap where there should be no motion even at the border. Suppose this plain covered with ice and snow in such a manner that the lower edge is very thin, increasing imperceptibly in thickness as one goes towards the pole, but with no high land to give initial motion. It is probable that the ice might accumulate for centuries, and then melt and pass away and leave no traces behind it.

Such a plain is that reaching from the Gulf of Mexico to the Arctic Ocean.

Should there be on our supposed plain isolated mountains or land slopes, with or without mountain chains, there would be local action as the ice-cap gathered; followed, however, by a period of quiescence, as it became more truly telluric in extent and blotted out the surface inequalities. As the ice covering was disappearing, these mountains and slopes would often produce the phenomena incident to local glaciers, ploughing over the ground, grinding to powder the rocks, or scoring their record on the polished surfaces. Each of these elevations might become a local centre, from which the ice moved in lines somewhat radial. As it sank away, new and secondary centres of movement might be developed until the force was exhausted.

Hence there may be indications of *local* glaciers, which in fact are the residua, so to speak, of the great telluric ice

From all these considerations I think there can be no question as to the existence of the *kind* of upheaval which my theory requires. Nor is it any reasonable objection to it that I am unable to give a satisfactory explanation of its cause. My ignorance has no bearing upon the actual occurrence of such a movement.

There are, however, some facts well worth considering in this connection.

Upheavals and depressions seem to be normal to all members of our system. They are occurring now on a vast scale in the Sun. If some of the best observers can be relied upon, upheavals that dwarf all that our theory calls for upon our planet, are now taking place in Saturn.

Sir William Herschel reports observing such an upheaval on the "shoulders" of that planet, so immense that the greatest and least diameters were to each other as 36 to 32, that of the equator being only 35, indicating a movement of more than 1000 miles outward on a side, or reducing it

cap, in places where the latter has left no traces of its presence.

Mr. Lyell, in his Principles of Geology, page 107, says, "We must not omit to dwell on the important effects to which a wide expanse of perpetual snow would give rise. It is probable that nearly the whole sea from the poles to lat. 45° would be frozen over."

Such an ice-cap would deserve to be called telluric, and in time would freeze that portion of the ocean solid to its lowest depths.

to the scale of our earth, indicating an upheaval above the surface of the sea of more than 100 miles, a movement vastly exceeding the amount needed for changing the position of the earth's axis.

I condense the following from the Cornhill Magazine, September, 1873: That movements are now going on in some of the planets and in the Sun, on an immense scale, is probable, from the results of the most careful observations. In 1803, Schröter found that Saturn's figure was distorted. In 1855, Coolidge noticed the swollen appearance of this planet about lat. 20°; yet not long after, it resumed its usual form. The two Bonds have seen the square shoulders, and have noticed other variations of shape. It seems to have been rendered probable by Secchi and others, that our Sun's globe varies in diameter.

As to the mode of action by which crumpling of the strata was avoided, I might suggest what, at least, is not physically impossible. If the equator became slightly elliptic, its perimeter would not be diminished, while its area would become less, necessitating a northern and southern prolongation. If the perimeter became slightly less, if, for example, the present diameter became the major axis, the polar-ward movement would be vastly greater. There is even now, if astronomers are not mistaken, a residuum perhaps of that movement, in the present ellipticity of the equa-

tor, one of whose diameters is nearly two miles shorter than that at right angles to it. If the longer diameter remained unchanged and there was no radial condensation (of which there can be no positive evidence), such a shortening of the other diameter required an upheaval of 33,000,000 cubic miles about each pole.

Unaccountable as at present such a movement appears, it is really no more extraordinary than those which show their traces in the irregular perimeter of a section of the earth parallel to the equator, and far less so than those which have been noted in Saturn.

Having established the fact that a circumpolar upheaval has occurred, it remains to inquire how large a one would be needed, and whether one of that extent could have occurred. It is no longer a question of kind, but of degree.

And first let me caution the reader against concluding the non-existence of a sufficient upheaval on account of what seems to him its great magnitude, for he must remember that but little (nothing ?) is known of the cause of any upheaval, large or small, and in our ignorance we have no facts whatever on which to estimate its possibilities.

To arrive at any positive results it is neces sary first to determine the cubic amount of a sufficient polar upheaval.

To reduce the spheroid to a condition of indif-

ferent equilibrium, it would be sufficient to change it to a sphere, a change necessitating a shortening of the equatorial radius of about four and a half miles. The surface of this sphere, whose contents would be exactly the same as the spheroid's, would cut the surface of the latter in the thirtieth parallel of latitude, and would recede from it uniformly to the poles, when the distance between them would be 8.8 miles. This earth-cap, covering each pole, is the measure of the mass to be added to the spheroid by what would be, in effect, a transfer from equatorial regions. The contents of these two caps would be approximately 293,000,000 of cubic miles. Any excess would turn the axis from the perpendicular.

Inconceivably great as is this amount, it is less than one-eighth of one per cent. of the entire mass. On a common thirteen-inch globe, its maximum of elevation would be less than one-seventieth of an inch, an amount not visible on such a figure to the closest observer.

Still, relatively small as it is, it is yet absolutely large, and needs to be accounted for.

Mr. Lyell, Prin. Geo., p. 111, has given an imaginary map of the globe, showing a possible upheaval of polar lands and depression of equatorial, such, however, that the amount of water and land surface remains unchanged. This he presents as a supposable condition that would account for the cold of the glaciers. As the land is raised

above the ocean bottom three or more miles, we should, if Mr. Lyell's hypothesis became a reality, have in that a portion of the transferrence required,* no small part either, for the continents with their shoulders and neighboring shallows cover an area of nearly 70,000,000 square miles. This, multiplied by the average ocean depth, 3 miles, gives say 210,000,000 cubic miles. The area of these polar caps (i. e. from 30° N. and S.) of which we have spoken, is about 100,000,000 square miles. If this were raised on an average 5,280 feet, it would add as many cubic miles.

To this it may rightly be answered that a part of the present land is in these very circumpolar regions, and hence, in their case, there would be no change of condition. Very true; but suppose the mass uplifted is in addition to the land already in those parts, then the entire upheaval would be a turning power. On these hypotheses, with the effect of the equator becoming elliptical, we have 376,000,000 cubic miles, sufficient to place the globe in a state of indifferent equilibrium and leave free 83,000,000 cubic miles. Another mile of elevation would add 100,000,000. Such an elevation undoubtedly would commence with a gradual slope and increase towards the pole, where a given mass would be most efficient.

* I use the words transfer and transferrence for convenience merely. There was the same result that a transfer would have produced, but really no transfer, save, as I shall show, of water.

There is another force of no mean amount, yet to be considered. I mean the actual transfer of water from the equator to circumpolar regions, and the accumulation of it there as ice.

I have already discussed the impossibility of predicating the absence of glaciers, because the characteristic striæ are wanting. The ice over so vast an extent may have come and gone and left no sign over large tracts. The polar regions became intensely cold, partly owing to the moderate surface of water, partly to the general elevation of the land, partly to derangement of warm currents, and partly to the small altitude of the sun, which then rose to a height 18½° less than at present. It may be that our earth was in one of those epochs of greatest eccentricity, of which Mr. Croll speaks, or, as has been suggested, our system was passing through a colder portion of space. These reasons may all be considered as in part explaining the intense cold, although for myself I cannot accept as true either of the last two. But the fact remains, the circumpolar regions became during the epoch of polar upheavals intensely cold. Land and water became covered, down to 45° and more, with a coat of ice.* The equatorial waters, by the law of their being, could never cease to evaporate, as long as any water remained, until the air became permanently saturated. Such a saturation could never occur, for the vapors

* Lyell, Elements Geol., p. 107.

rising and passing into the *cold regions North and South*, discharged their moisture, which, changing to ice, remained. The vapors continuing to rise, continued to be condensed, towards the cold poles. The operation was precisely similar to that of the common philosophical instrument called a cryophorus. Every one who has witnessed this experiment has seen the water in the warm bulb pass as vapor into the cold one, where it is condensed and frozen, the process continuing until the water is exhausted.

Hence it follows that there was a steady transferrence of water from equatorial to polar regions, and but for the melting at the lower edge of the glacier, the whole ocean must have been, in time, exhausted. The result was an immense polar ice-cap falling away towards the lower edges, while the northern and southern seas became frozen solid.

If one-half the equatorial waters was thus transferred, the ice-cap must have been equal in weight to a layer of the same materials as the continents, containing something like 50,000,000 cubic miles.

Taking all these into account, we have an excess over the polar earth-caps sufficient to make our spheroid a sphere, amounting to say 233,000,000 cubic miles. As this excess was directly or indirectly taken from the equatorial portion, the deficiency there acted in the same sense, and really doubled the effect.

In comparing the effect of a circumpolar excess with the influence of the Sun and Moon on the equatorial protuberance, it must be borne in mind that the former was a constant force, while the latter is intermittent, varying twice in a year from its maximum to zero.

I have thus roughly indicated the possible working of forces of upheaval. The greatest, and I may say the only difficulty, is their vastness.

I cannot say that I attach much weight to the idea that all land became polar. Perhaps it would be better to say, without attempting any details, that this movement was caused by immense polar upheavals, aided by the inconceivably great accumulation of ice.

This storing of the waters of low latitudes as ice in circumpolar regions, is an explanation of a difficulty that has probably occurred to the reader in reference to the shortening of the equatorial radius, viz. that such a shortening would, by the ordinary laws of motion, cause a gathering of all the water of the globe at those parts, and a consequent submergence of the continents, a deluge of whose existence there has no proof been discovered. But since the water was carried by the atmosphere North and South, and then deposited as ice, any such catastrophe was rendered impossible. Instead of a deluge, there was more probably a drought.

One other fact is not out of place. If the con-

tinents retained their present altitude, the persistent evaporation, with consequent loss of heat, would of itself reduce the equatorial temperature, while the sinking of the surface of the ocean would produce the same effect as elevating the land, giving it a rarer atmosphere, and less power of retaining solar heat.

Thus the movement by its own effects intensified itself. Such effect, moreover, would explain the fact that the destruction of the higher pre-glacial animal life appears to have been so universal.

It remains only to supplement this discussion by showing that the present difference between the inclination of the earth's axis and that of the moon's orbit is not in any large degree due to a movement of the latter.

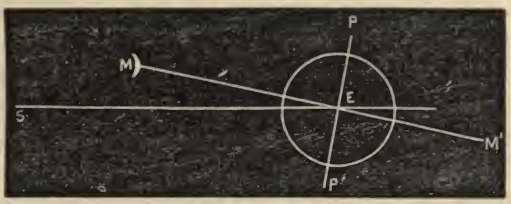


FIGURE 3.

Let Fig. 3 represent the Sun, Moon, and Earth, while the Moon's orbit yet coincided with the plane of the Earth's equator. We will suppose too, that the axis PP′ was inclined in a sensible

degree to the ecliptic, say 5°, a condition whose origin and cause will be considered in "Cosmology."

At that epoch, then, the difference between the inclination of the Earth's axis and that of the Moon's orbit, was null. It is evident that the Sun's attraction upon M could not affect the mean position of its orbit, for the decreased inclination at M will be nearly counteracted at M′, leaving a small residual in favor of M, on account of its less distance from the Sun. This small residual will be fully counterbalanced when the Earth has moved to the opposite side of its orbit, giving then to M′ an exactly equal superiority over M, and leaving the total effect absolutely nothing, in exact harmony with La Grange's Theorem.

In precisely the same manner it can be shown that the influence of the other members of the Solar System lying outside of the Moon's orbit, will be equally null.

Ergo, the present difference of inclination which we are considering, is not due in the least to a movement of the Moon caused by any action of Sun or planets.

Could it have been due to a movement of the Moon, caused by the Earth?

The Earth, as a true sphere, could produce no movement whatever. We must, then, look to the effect of upheavals. I shall show that no considerable part of this difference, 18½°, is due to a

movement produced by the attraction of massive upheavals upon the Earth's surface.

Suppose, all things remaining as before, a great upheaval at one of the poles P, the Moon being at M'. Evidently M' would be drawn towards the ecliptic, but when it had passed on 180° to M, it would be drawn an equal distance away from the ecliptic. Hence no permanent effect whatever could be produced. There certainly is, at the present day, a separation of 18½°. I have shown that it could not possibly be due to the movement of the Moon's orbit, hence there is no escaping the conclusion that it is due to a movement of the Earth itself.

Quite possibly the reader may here say, True, there could be no movement of the Moon generated by massive upheavals upon the Earth's surface, providing that the two axes then had the same inclination, and so far your proposition is the enunciation of a fact. But as you have shown that a polar upheaval upon the Earth would, on condition of a prior inclination to a sensible amount (5°), result in a movement of the axis, so it may have happened that from some cause the Earth's axis was inclined a little more, causing the plane of its equator and the Moon's orbit no longer to coincide, then perhaps the remainder of the 18½° was due to a movement of the Moon.

I shall endeavor to show that even if these were inclined at any supposable angle, very little

effect could be produced upon the Moon's position. For, first, the distance of the Moon from the centre of the Earth being sixty times greater than that of the polar mass P, it is evident that any force exerted by P to move M, will, by the laws of composition of forces, act at a great mechanical disadvantage, while the opposite will be true of the effect of M to turn the Earth, a difference much more than sufficient to counterbalance the difference in their sizes (masses). Second, If the Moon was raised just as many miles as the pole P is moved from its position, the angular change would be far from equal, a movement of 10° on the Earth being equal in miles to only 10′ at the Moon.

Hence the conclusion, as far as I can see, is unavoidable, that the movement of the lunar orbit was very small; a result fully corroborated by the position of all the other satellites save one, the cause of whose singularity will be hereafter discussed, and consequently that the present difference between the inclination of the Earth's axis and the axis of the Moon's orbit, is almost wholly due to a movement of the Earth itself.

CONCLUSION.

I conclude then, that the attraction of the Sun and Moon upon polar protuberances, is the physical cause of the present inclination of the axis of the Earth.

A polar elevation acted upon by Sun and Moon, and in some degree by the planets, turned the pole of the earth towards the ecliptic in an ever-widening spiral, until, the mass returning to its normal position, the movement ceased, owing to the attraction of these same bodies on the equatorial belt. This attraction acting by itself would have caused the equatorial protuberance to draw the equator not only to the ecliptic, but by the usual laws of matter to pass on as far beneath, until again stopped by the attractive force, to be again drawn back, thus, like a mighty pendulum, vibrating back and forth forever. This result now actually exists, disguised, however, by the axial and orbital motion of the earth, and resulting in the precession of the Equinoxes.

It may be noticed as a curious circumstance that during the predominance of the polar attraction, instead of a precession of the Equinoxes, there was an apparent movement in the opposite direction.

RESUME.

AS TO THE EPOCH OF AXIAL CHANGE OF INCLINATION.

1. There was no telluric axis before the Earth was segregated from the great Nebula.

2. The normal lunar-telluric axis was perpen-

dicular to the Cosmic equator, and hence, to the plane of the Earth's orbit.

3. The lunar orbit is now inclined 5° 9′

4. The Earth's axis is now inclined 23½°.

5. The two were once parallel. They now differ nearly 18½°.

6. This difference is subsequent to the avulsion of the Moon, and is, in only a very small degree, due to a movement of its orbit.

7. This difference is almost wholly due to a movement of the Earth.

8. From the uniform distribution of fossils, we learn that the Earth's axis, till well towards the Epoch of the Glaciers, and probably into that period to some extent, was almost perpendicular.

9. The closing period of the time of perpendicular axis, the Tertiary, was distinguished for the completion of land development, and biologically for the appearance and predominance of modern Grasses, Angiosperms, and Palms, i. e. "the tree yielding fruit whose seed is in itself."

After this followed the Glacial Epoch.

10. At the earliest period after this Epoch of which we have any knowledge, the axis of the Earth had its present inclination.

Hence, as this change occurred after the Tertiary, and before the Historic period, its epoch is between them, i. e. IN THE GLACIAL EPOCH.

AS TO THE CAUSE OF AXIAL CHANGE.

1. It was not a cause outside of the laws governing the rest of the System.

2. It cannot be due to Magnetic forces.

3. It cannot be due to collision with Meteors.

4. It cannot be due to any centrifugal force.

5. It could have been produced by the attraction of the Sun, Moon, and Planets upon polar upheavals.

6. No other force yet known could affect the Earth's position.

AS TO THE REALITY OF SUCH UPHEAVALS.

1. Immense upheavals are now occurring on Saturn and on the Sun, as well as, upon a smaller scale, upon the Earth.*

2. We know of no law or circumstance determining their limits, and are equally ignorant of their cause and of bounds to its power. At this moment there is a difference between the lowest

* Mr. Horner, in his Address to the British Association, 1846, p. 63, says: "That land in various parts of the earth has undergone movements of elevation and depression, and that it has been subject to such oscillations at all times up to the present day, admits, I think, of no doubt." He quotes Mr. Darwin as saying that "daily it is forced home upon the mind of the Geologist, that nothing, not even the wind that blows, is so unstable as the level of the crust of this earth." Strong language, and probably uttered under the impulse of strong feeling, yet sufficiently exact to fully sustain my position.

depression and the highest elevation of about 16 miles.

3. Polar upheavals occurred during the Glacial Epoch on a scale surpassing any telluric movements of which we have any knowledge.

4. There was at the same time an extraordinary transfer of water from equatorial regions to polar, where it was piled up as ice, thus diminishing the equatorial protuberance and increasing the polar upheaval.*

* Since the above was in type, I have seen the very able article of Messrs. Newcomb and Holden, in the American Journal of Arts and Sciences, October, 1874, which appears to dispose of the existence of *periodic* variations of the Solar diameter. Those of a temporary and irregular character, however, may exist, indeed, must exist, if the upheaved masses of Hydrogen, or other matter, be considered as part of the Sun, since a diameter measured through such an upheaval would be longer than one measured elsewhere. *Regular periodic* changes of real diameter are inconceivable, but *spasmodic* changes are normal to the whole system, and although subject to law, yet it is a law so complicated that as yet it has been impossible to do more than to record their occurrence.

One word as to the strange distortions of Saturn. It is suggested that these are in some way due to the attraction of its Satellites; but, if this were so, they would necessarily recur in a Cycle, giving a rhythm to their movements of which there are no indications.

ANOTHER THEORY.

One of the peculiar advantages of a phenomenal description is that it cannot be destroyed. It possesses a vitality that refuses to yield to friend or foe. Positive refutations equally with erroneous explanations, leave it unharmed. Thus it will be with the Mosaic account of the fourth day's work; if it represent actual occurrences, its truthfulness is in no degree dependent upon the correctness of our theories. Hence, should the reader be able to show that the explanation here given, has no ground in the facts of our world's history, it would be grossly illogical for him to deduce the conclusion that the Narrative itself is in like predicament.

I have developed in the preceding "Inquiry" what seems to me the true exposition of the work of the fourth day, and have endeavored to coördinate all the physical facts bearing upon the subject. There has also occurred to me another Theory, which I give for what it is worth. It accords with the *facts* of the world's history better than any explanation of which I have read, and, if I overestimate the value and truthfulness of my solution, may aid in obtaining the true one. It is not satisfactory to myself, because it lacks that sharp literalism which seems to me one of the most

marked peculiarities of the Mosaic Account, and does not follow the text into every phase of expression. It lacks, too, that marvelous interlinear reading, so characteristic of the preceding verses.

We may suppose, then, that the earlier Geological Ages, at least after the Cretaceous, had a sky nearly as clear and a Sun as bright as ours, and that under its genial beams "the earth brought forth grasses, herbs, and the tree yielding fruit whose seed is in itself" (i. e. angiosperms and palms), as well as the varied preglacial fauna. That towards the close of the Tertiary, when such a flora had become dominant, the cold of the telluric glacial winter set in, and that dense clouds hiding the Sun, the Moon, and the Stars, gathered over all the world, bringing back almost primordial darkness.* That during this long time of ice and darkness, one unchanging season of almost endless winter prevailed. At last, from some unknown cause due to the Divine Worker, warmth revisited the earth, the clouds cleared away, revealing, as if a new creation, the greater and lesser lights, and "the stars also;" the monotony of the world-wide winter was fol-

* These clouds and darkness have not, as far as I am aware, any sufficient foundation in fact, but for aught I know, they may have occurred.' This is as good authority for the assertion as belongs to many Scientific theories as well as to the greater number of the explanations of the account given in Genesis, which have fallen under my observation

lowed by the pleasing vicissitude of Spring and Summer, Autumn and Winter, a joyous procession that has ever since brought seed-time and harvest.

The fauna of water animals and fowls, which were so appropriate to the close of the reign of ice and cold, would harmonize equally well with either of the explanations which I have given of the work of the fourth day.

COSMOLOGY.

THE study of the influence of Solar and Lunar attraction upon telluric upheavals, leads to a field of inquiry by no means limited to the planet on which we live. It may seem not germane to the subject which thus far has occupied the reader's attention, but as I have shown that a successful denial of the Mosaic Narrative would annihilate the Nebular Hypothesis, and on this conclusion have based an argument for the reality of a Revelation, it cannot be out of place to present here evidence which tends to establish the truth of that remarkable Theory.

Leaving out of consideration the usual proof derived from observations made with the telescope and spectroscope, I propose to confine myself to an attempt to show that the present phenomena of the Solar System, or others of precisely similar character, are the *necessary* results of such a condition as is implied in the word Nebulous. I shall assume nothing that is not an admitted truth, or that does not find its analogue at the present moment in some part of the universe. As such may be

reckoned the universality and uniformity of gravitation and the laws of motion, while the true Nebulæ now to be seen in various parts of the heavens, present the very condition which this Theory demands for our own Solar System. The upheavals which will be required are similar in character, but proportionately larger than those of whose existence on the Earth, the larger planets, and the Sun, we have such ample proof.

I shall, then, assume that the Solar System at some inconceivably remote period, was a nebulous mass of almost infinite rarity, extending beyond the orbit of Neptune, and that it was affected by the present law of gravitation, and was subject to the laws of Motion.

I shall also assume the existence of upheavals in this great mass, and endeavor to show that in these assumptions is a key that so readily unlocks the difficulties of our System, so readily and easily accounts for phenomena so various, that it is impossible to resist the belief that in them we have the true physical cause of the present arrangement of the Solar System as well as of the smaller systems that centre about some of the planets.

It is evident that the atoms of a homogeneous sphere of nebulous matter under the sole influence of gravity, would move centreward in radial lines, since the lateral attractions would neutralize

each other, and that, in reference to them, the system would be in a state of unstable equilibrium. Any disturbance, however small, giving preponderance to a part, would result necessarily in a gyratory movement. As matter is powerless to originate any change of position, such a disturbance must have come from without. This derangement of equilibrium might result from the impact of some body, as the plunging in of a meteor, or the attraction of another system. Any explanation, however, only places us one step farther back, one nearer to the Source of Being and Power, and in the last analysis, reaches the Great First Cause. Sooner or later we arrive at the only explanation on which the mind can rest, "The Spirit of God moved upon the face of the fluid mass." *

In case, however, the mass was not a spheroid, or not homogeneous, states as much to be accounted for as an external impulse, the conditions for gyratory movement existed in itself. Any one of these causes would eventually result not only in a motion of rotation, but what was of great importance in the development of the Sys-

* Can it be that here is one more instance of the deeper, more radical meaning of the *words* of Genesis, striking a physical fact? Certainly the thought of a mighty wind, a "wind of God," the impact of the breath of God, the πνεῦμα Θεοῦ rushing upon the dark, formless mass, is wonderfully in harmony with the needed disturbance, and the resulting waves which rose and fell thenceforth through the ages.

tem, it would also produce an undulatory movement or wave of force, traversing the mass from side to side, echoed back as it were, and producing surface waves the precursors and causal antecedents of all the upheavals since.

From the laws of motion, I postulate the increase of angular velocity and centrifugal force, as condensation proceeded; the formation of the nebulous mass into an oblate spheroid; and the ultimate avulsion of a ring of similar matter, which revolved in the plane of the Cosmic equator, about the Cosmic centre, in the same direction as the parent mass, and which was, if without interfering cause, truly circular and of uniform section.

By Kepler's law establishing the relation between the times and distances, it is evident, since the Radii were very large and the distance between the surface of the helioid * and the inner surface of the ring was at first infinitesimally small and increased very slowly, that their angular velocities were for a very long time almost the same.

A POINT THEREFORE ON THE RING OPPOSITE A POINT ON THE HELIOID WOULD REMAIN SENSIBLY OPPOSITE FOR A PERIOD OF GREAT LENGTH.

* "Helioid" denotes that part of the great Nebula within a ring, or the orbit of a planet. It is the central portion and contains in itself the undeveloped planets and the Sun. "Planetoid" bears the same relation to a planet.

This fact is highly important, since it practically avoids all consideration of the rotation of the two, save so far as by generating a centrifugal force it held their centres at a fixed distance apart while leaving entire freedom of motion in other directions. In connection with the limited duration of the upheavals, it also eliminates that compensation which is the marrow of La Grange's celebrated Theorem in reference to orbital inclinations.

These upheavals occurred, most probably, in all forms and positions. Obeying the law of gravitation, they attracted other bodies, precisely as if the central body was not in existence. According to this law, the influence of a homogeneous* sphere on a body exterior to it, is not affected by any change in the diameter of either, providing the masses and the distance between their centres remain constant. In other words, if the Sun remained a homogeneous sphere, its attraction upon Neptune, for instance, would be precisely the same as now, although it were so rarefied as to reach within a foot of the latter's surface.

On the other hand, a mass lying upon the surface of the sphere will exert its influence precisely as if the latter was not in existence, and its attraction will vary, very nearly, in the inverse ratio of the square of the distance of the attracted body from the *surface* of the sphere. Consequently its

* Or, if homogeneous at equal depths

effect upon a given mass may equal or exceed that of the sphere itself.

Hence it follows, if the distance between their centres be constant, that the attraction of the helioid for a planet will remain constant forever, no matter how far their surfaces may separate, while the attraction of a mass lying upon the surface of the central body, and moving with it, will be a variable quantity having its maximum as nearly as possible at the moment of avulsion, and diminishing as that body contracts.

Since no internal force can change the absolute position of the centre of gravity of a system (Principia), it follows that an elevation so caused at any point, will always be accompanied by an equivalent movement in the opposite direction, and on the other side of the centre of gravity. This may manifest itself, either in another upheaval on the opposite surface, or it may take the form of a more or less general movement of the rest of the mass in a direction opposite to the first, but to a relatively smaller distance. But in the consideration of masses of such inconceivable size, the distance from one side of the helioid to the other is so great that the effect of the opposite upheaval may for the most part be entirely neglected.

In these elementary principles are found the conditions necessary for the formation of a system with the peculiarities of our own. They contain

also such elements of variation as to account for other orders and arrangements such as we may conceive to exist about other Suns, but of which we can have no knowledge other than the possibility of their existence.

I have spoken of our Cosmos as normally a regular body, a real spheroid, if not a sphere, an assumption made to avoid complications in the reasoning. Although it could not have been as irregular as some nebulæ of which we have knowledge, or it would have developed into a double or triple Sun-System, yet it is inconceivable that it was a really regular body. Whatever was its true form, it may, however, without error, be considered at all times a true sphere with protuberances or irregularities of various forms and sizes. These, from the nature of an elastic, mobile body, must have been ever-varying, and hence would give the conditions required, i. e. undulations as it were, rising at one time far above the normal surface, and then sinking back again to, or even below, their former place.

The following results flow from such a nebulous body of sufficient size, under the one condition of local, temporary * upheavals, and would be

* *Local* has reference to the fact that the upheaval, although millions of miles, perhaps, in extent, covered but a small fraction of the central body.

Temporary as Cosmology counts time, a trifle of a thousand years or centuries, some fragment of eternity.

equally true of all conceivable one-Sun Systems. They may be embodied in seven general propositions.

Prop. 1. There will be an evolution of a series of planets.*

Prop. 2. The orbital motion of the planets and the axial revolution of the central body will normally be in the same direction.

Prop. 3. The axial revolutions of *all* the planets will *normally* be in the same direction as the orbital.

Prop. 4. The planets will have elliptic orbits of unequal eccentricity.

Prop. 5. The planes of these orbits will be inclined at various angles.

Prop. 6. The planes of their equators will be inclined to their orbits at any angle from 0° to 180°. N. B. An inclination exceeding 90° gives the retrograde motions of the Satellites of Uranus and Neptune.

Prop. 7. Great differences will be possible between the direction of the orbital motion of satellites and that of their primaries.

Although these conditions are actually found in our system, yet they might have been deduced *a priori*, by one who had no knowledge of their

* The masses of the planets and the planetary distances, although results of the nebulous condition, do not come within the present discussion, being dependent upon principles not now under consideration.

actual occurrence, as I shall now endeavor to show.

I shall assume, without argument, that a spherical gaseous mass, revolving as we have supposed, and shrinking in bulk, would generate an oblate spheroid, and that then, as the centrifugal force became equal to the centripetal, a separation, or avulsion, of a ring of similar matter would occur in the equatorial protuberant belt; that as this belt was truly circular, so would be the ring; and, as our supposed spheroid was homogeneous at equal depths, every section of the ring made by a plane passing through the cosmic centre, and perpendicular to its equator, would be equal to every other section similarly formed; and, as there was no cause for change, the ring must continue to move in the same direction as the parent mass.

PROPOSITIONS 1 AND 2.

Commencing, then, at the exterior of our System, we will suppose the first cosmic ring just left behind by the contraction of the helioid, and that, not long after, an upheaval occurred on its equatorial portion.

This upheaval, being exterior to the spheroid, would act upon the ring as if the latter was not in existence, and, being very near to one side of it, would greatly disturb its equilibrium, causing an acceleration of the velocity of the portion behind

it, and a retardation of that in advance.* This would cause, in the ring, an accumulation or nucleous, which, once formed, would continue to draw to itself the remainder, until all was collected into one mass. This mass would necessarily continue to revolve about the Cosmic centre in the same direction as the ring, and hence as the helioid itself. This first body, in our system, would be the embryo planet which we now call Neptune. A repetition of this process would produce planet after planet, until the helioid had shrunk to a body too small, or too solid, to generate any more, and, for lack of reason to the contrary, each would revolve in the same direction as the central mass. Q. E. D.

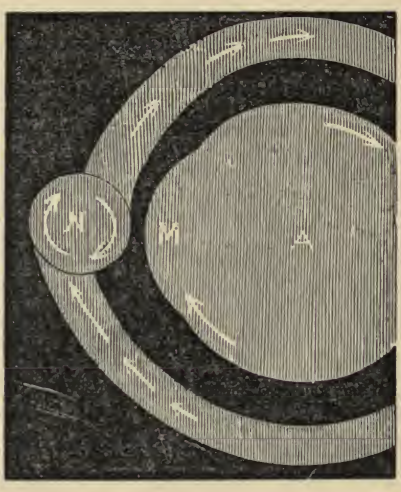
Here I may remark that two or more such upheavals might occur in the time of one ring, at a great distance apart, and that this would result in the formation of two or more planets, at equal distances from the centre, a condition of which some of the Asteroids furnish an illustration. The relative size of such twin planets would depend upon the distance apart of the upheavals, as well as the length of time one appeared before the other.

PROPOSITION 3.

From this same equatorial upheaval other important results flow.

* Fig. 4 illustrates this; q. v.

FIGURE 4.



A is the axis. M the upheaved mass. The shorter arrows denote decreased velocity; the longer ones, increased velocity. N is the nucleus of a planet.

Fig. 4 represents an equatorial section of the Cosmos, although a very distorted one. We here have the conditions just described. Not only would the atoms on one side approach the nucleus N with an increased velocity, but this would generate an increase of centrifugal force, causing them to recede somewhat from the Cosmic centre, while the atoms in advance would, for the opposite reason, have less centrifugal force, and be drawn nearer the centre. Omitting all consideration of the absolute motion, and looking only at the rela-

tive, there will be, in effect, two streams of nebulous matter moving in opposite directions towards the nucleal point, the medial line of the one falling nearer the centre of the system than that of the other, thus generating an axial revolution in the same direction as the orbital. As precisely the same action may be supposed to occur in case of all the planets, the same result must follow, thus establishing the truth of the third Proposition.

PROPOSITION 4.

The body opposite M as yet possesses none of the planetary characteristics, save axial and orbital movements, the latter in a path truly circular—so far, at least, as any cause to the contrary has been shown. This brings us to the fourth Proposition.

By the laws of motion, the angular velocity of the helioid exceeded somewhat (not much at first) that of the ring, or its subsequent planet. Consequently, the mass M kept in advance of the embryo planet, and continued to accelerate the latter's rate of motion, its influence at the same time gradually diminishing until the distance between them became 180°, when its influence became zero, and then negative for the remaining 180°. A precisely similar effect would have been produced had the upheaval continued for a part of a revolution, or had it been followed at a sufficient interval by one behind the planet. The effect of

such acceleration and retardation was necessarily that variation of velocity that can only exist in an elliptic orbit.*

Hence, in the disturbing force of the attraction of such an upheaval, we find an influence that would necessarily generate elliptic orbits, and as the upheavals could scarcely be equal in size, position, or duration, either actually or relatively, there would arise a great variety in the eccentricities of these orbits. Therefore, on *a priori* grounds, we should expect the present variety in the forms of the orbits of our System, in harmony with the Proposition.

As the same result might flow from a succession of smaller upheavals, and as it is not reasonable to suppose any regular order in them, we may conclude that some aided the movement, while others retarded it, and hence follows the curious result that the mean eccentricity of the same planet's orbit may have been, at some of these early times, greater, and at others, less, than at present.

PROPOSITION 5.

For the sake of simplicity, I have supposed the orbital and axial motions, as well as the ellipticities of the orbits, attained while they were yet

* I do not speak of a parabola or hyperbola, for these forces could not generate such a curve, since no body can, by its own attraction alone, impart to another a force sufficient to send it beyond its reach.

in the plane of the great equator. Returning, as before, to the exterior planet just after its segregation and collection into a spheroid, we may imagine another upheaval occurring on the helioid, which, as yet, nearly filled the space within the planet's orbit, at some considerable distance from the equator, as 40° or 50°, but, if I may use such an expression, in the plane of the same meridian as the planet. It is evident that the attraction of this mass will neither increase nor diminish the planet's orbital motion, and so far will be without effect. It will, however, to a degree depending upon its mass, distance, and duration, and upon the mass of the planet, lift the latter above its normal position. But as the centre of gravity of a system of bodies cannot be made to change its place by the action of forces in the system, and as this centre of gravity is the point about which the planet revolves, the orbit will of necessity become inclined.

If the upheaval had been permanent, it would eventually counterbalance its own influence, leaving the mean inclination of the orbit unaffected, but its temporary character, so to speak of cosmic durations, paradoxical as it may appear, gives permanency to its effects. This, for the very simple reason that before the time and position come around for it to act in an opposite sense, or to lift the other end of the orbit, it will have sunk to the general level.

As it is scarcely possible that the subsequent upheavals, in reference to the planets interior to Neptune, were all of the same size, duration, distance and angular direction, we are certain, *a priori*, of a corresponding variety in their orbital inclinations.

Hence, given a Nebulous mass and local upheavals above or below the equator, the orbital inclinations follow of necessity, with all their variety of degree, and thus establish the truthfulness of the fifth Proposition.

THE AXIAL INCLINATION.

Although I have not yet exhausted the effects produced by an upheaval of a portion of the central body, it is now necessary to consider the behavior of the inchoate planet.

As has already been said, an axial rotation of the inchoate planet, in the normal direction, was generated, and I now add that this rotation was made yet more rapid by the condensation of the matter forming the nebuloid.

Attempts have been made to give the equation of axial revolution, but so many elements which must always remain indeterminate, enter into the calculation, that the true equation* appears impossible to be obtained. We cannot tell how much of

* The true equation should give the time of rotation at any period of the planet's existence, either when it possessed the intense heat of some former epoch, or when it shall have cooled to the temperature of surrounding space.

the primeval force was radiated as heat into space, or disappeared as chemical force, or in other ways.

For a like reason, it probably will always be impossible to find the formulæ representing the inclinations and eccentricities in terms of those movements from which they have been derived, precisely as it is impossible to give the formula for the shape of a pebble on the sea shore. We can show how its form was attained by the action of the waves dashing it against its fellows, and that such action would necessarily result in a greater or less approach to the form of a sphere. We can also, knowing its lithic character, and the direction of the planes of cleavage, determine, *a priori*, the position of its three axes, but there we must stop. The infinite number of modes of applying the blows, the varying degree of hardness in the pebble itself, or in those about it, the solvent power of the water, etc., introduce such a flood of indeterminate quantities, that the finite mind is baffled. The Cosmic mass, the rings and the planets, were subject to an infinite variety of influences, from the ever-varying shape, size, position, and duration of these upheaved masses. We can qualitatively show their results, but can never throw their influences into the form of equations.

PROPOSITION 6.

The normal position of the axis of the planetary nebuloid was perpendicular to its orbit, and,

if it had at that time the form of a true sphere, no effect upon the direction of its axis could have been produced, either by the central sphere itself, or by any upheaval upon its own surface. Whatever change of position the planet or its orbit might undergo, the axis of the former would remain parallel to itself.

I now propose to consider the form of the nascent planet.

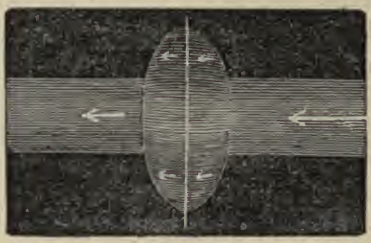


FIGURE 5.

Fig. 5 represents a portion of the ring gathering about a planetoid, the larger arrow, as in Fig. 4, denoting the portion of the ring whose speed has been increased, and the smaller, that which moves more slowly. The effect of such a condition was to produce a lateral pressure upon the mass as it revolved on its axis, resulting in its elongation in the direction of its poles, exactly as a bar of hot iron rotating on its longer axis while receiving the blows of a hammer, is elongated. This prolateness must have continued during the aggregation of the planetoid, and afterwards, until

the latter's own centrifugal force caused it to change to an oblate spheroid.

From this elongation, highly important results followed, viz. the inclinations of the axes of the members of our System.

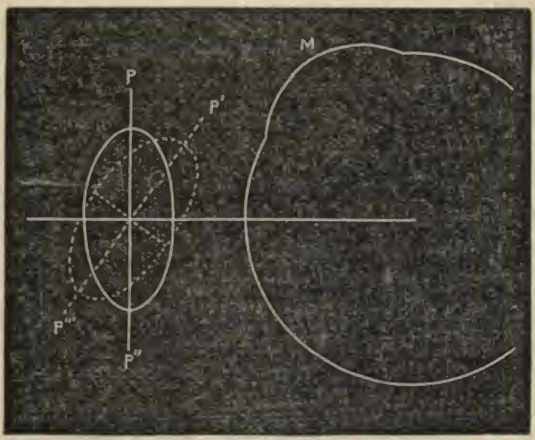


FIGURE 6.

Let Fig. 6 represent the Solar System during the aggregation of Neptune, while the latter was yet prolate, and while its axis was yet perpendicular to the Cosmic equator.

It is evident that while the helioid remains a true spheroid, its attraction can produce no effect upon the position of the planet's axis. But if a mass, M, be upheaved, as in the cut, the attraction of M on the nearest hemisphere will cause the

body to incline towards it, and to assume a position rudely shown by the dotted line.

It is furthermore evident that as soon as one hemisphere begins to approach the helioid, it will, from its nearness, be more strongly attracted than the other, and consequently that the great central body will aid and continue the effect of M. Consequently, the axis will lean more and more from the perpendicular towards the plane of its orbit, which it will reach in due time, unless prevented by some other force, which might, under favorable circumstances, come from an upheaval below the helioid's equator, but more frequently from the stability engendered by the development of a sufficient oblateness in the planet. It is also evident that these counteracting influences might come sooner in case of one planet than in another, giving rise to a corresponding variety of effects. Another source of variation is found in the fact that a large upheaval on the central body would produce a greater inclination of the axis of the planet than a smaller one, and again, that the effect upon a large planet, other things being equal, would be less than upon a small one. Hence, we should expect the axis of Jupiter to be less inclined than those of the other planets. Yet, since the the size, distance, and angular position, as well as duration of those upheavals, were in the highest degree variable, it is as certain as the doctrine of Chances can make it that there would be de-

veloped in any system, under such influences as these, all the variety of axial or equatorial inclination that now exists; thus establishing the truth of the sixth Proposition.*

It is easy enough to see, from this, how readily it would happen that Jupiter's axis should be almost perpendicular, while that of Venus is so very much inclined, and that this is easily consistent with their different degrees of orbital eccentricity.

THE RETROGRADE MOTIONS OF THE SATELLITES OF URANUS AND NEPTUNE.

The Retrograde Motions of the Satellites of Uranus and Neptune have long been the *bête noir* of astronomers, obstinately refusing to take a place in any theory. Yet I venture to affirm that no planetary phenomenon is more easily explained than these, upon the principles which are under consideration.

Either of these planets, when passing from the state of being a ring, must, as already shown, have been at first a prolate spheroid. Its then condition, and the effect of a cosmic upheaval, are well indicated in Fig. 6. If this upheaval had come and gone, and the corresponding obliquity

* The reader will constantly bear in mind the almost equal angular motion of the planet, and the upheaval affecting it, an equality, as I have said, which arises from the small difference in the length of their immense radii. This is a condition of the highest importance.

of its axis had occurred, before the embryo planet had received all the ring-matter, it would retain its prolateness, and be drawn, by the attraction of the great central body, into the plane of its orbit. We need only suppose that another undulation then occurred below the equator. Such a mass would draw the nearest pole still further from its normal position. If this movement carried the pole of Uranus 10° below the plane of its orbit, and that of Neptune 60° (?), there would be the present reversed position of these planets. To complete the present arrangement we need only suppose, the aggregation of ring-matter having been completed, the centrifugal force no longer repressed by lateral pressure, the nebulous mass allowed to obey it freely, together with an interval of comparative Cosmic quiescence, and there will be given all the needed conditions for the development of their systems of satellites, with their retrograde motions, a result that further confirms the truth of the sixth Proposition.

It is hardly necessary to remark that the succession of upheavals would not, in reality, be so distinct as I have indicated. One upheaval, properly placed, might produce nearly all these effects at once. It will be easy for the reader to discover how this could be.

PROPOSITION 7.

The Rings, and nearly all the Satellites, re-

volve around the primaries almost in the planes of their equators. But our own Moon, and Saturn's outermost, cross these planes at comparatively large angles, the one making an angle of about 18°, and the other of nearly 14°.

Although these anomalies have attracted so much less attention than the retrograde motions of the Satellites of Uranus and Neptune, they appear equally extraordinary. It certainly is remarkable that the rings of Saturn, and the large number of seven Satellites, scarcely vary from one plane, while the eighth abruptly takes a course of its own.

Our Theory does not fail here, but shows even this to be a development of law, and one of the echoes of that first impulse on the inert Cosmic mass.

We will suppose the Saturnian planetoid inclined something more than 28°, in the manner already shown, PROP. 6, and as illustrated by Fig. 6; that, while in this position, the planetoid, by virtue of its axial rotation, became oblate, and at length separated from its equatorial belt, which, as shown in case of the larger bodies, was gathered into a sphere, the embryo moon. This must have revolved, at first, in the equatorial plane of the future planet, the system at that time being represented rudely by the accompanying diagram.

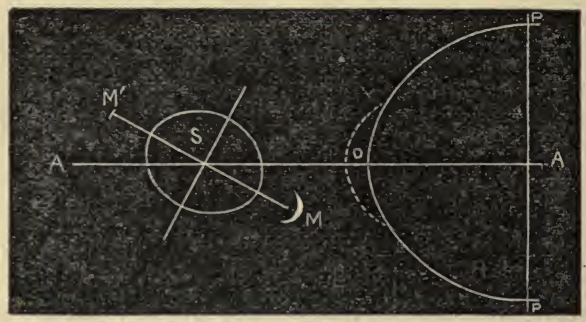


FIGURE 7.

AA is the plane of the equator of the helioid, PP being its axis. S is the future planet Saturn, at that time extending far beyond the present orbit of its seventh Satellite. MM′, the plane of the planetoid's equator, and also of the orbit of the oldest Satellite.

Suppose an upheaval to occur at O, on the larger body. It is evident, first, that the helioid itself, according to La Grange's Theorem, will not affect the mean inclination of MM′. Second, that the upheaved mass O will draw M * nearer to AA, but when the Satellite has passed around to M′, i. e. after a semi-revolution, it will be drawn away

* It must be borne in mind that La Grange's Theorem owes its existence to the invariable character of the attractive influences affecting the mass, but has no applicability to forces of a temporary nature. If O, Fig. 7, had been simply a belt, or even a permanent upheaval, eventually its influence on the position of M would be counterbalanced, and the mean inclination of the latter would remain unchanged. But the brief duration of O renders compensation impossible.

from AA. But as the distance from O to M is very much less than from O to M', the effect at M will be much greater, and will result in drawing the Satellite's orbit nearer to that of the planet.

Since the helioid at this epoch extended nearly to the line of equal attraction between the planet and itself, their rate of angular motion could have differed very little, and consequently the mass O remained near enough to the planet to exert an influence on the Satellite for a long time, indeed, during many hundred of its revolutions. How long a period would be required to produce the required effect, would depend upon the size and distance of O, and as these are both unknown, any quantitative answer is impossible. From the great size of Saturn's orbit, the influence of such an upheaval would not be very great in three-fourths of its Synodic revolution,* leaving one-fourth only as effective, or a period of about 300 years, equal to 1350 sideral revolutions of the Satellite, and ample time for a moderate upheaval to raise its orbit 14° from the planet's equator, as will be seen when we recollect that the attraction of the planet is sufficient to make it describe a similar arc in a little more than one forty-thousandth part of the same time. If, by the time the Satellite's orbit had been thus bent 14° from

* A Synodic revolution here would mean the time needed for the mass O, and the two centres S and A to come again into a right line. I assume O to be at the point where the attraction is equal between S and A.

its normal position, the upheaval had subsided, it would ever remain at that angle, since it would then be subject to La Grange's Theorem, and free from all interference.

In the meantime, what has been the effect upon the oblate planetoid? Undoubtedly, the protuberant equatorial belt was affected in precisely the same manner, but in an infinitely less degree. For, the diameter of the Satellite's orbit being so much greater than that of the planetoid, the difference in the lifting power of the upheaval would be much less in case of the latter, and besides this, it must be remembered that the Satellite is a mere bagatelle compared with the immense size of its primary.

If, now, the helioid continued to contract, and no more undulations (or upheavals) occurred upon it large enough, or near enough, to disturb the planet in its process of cooling and shrinking, there would be the conditions needed for the quiet evolution of Saturn's entire System.

In that case, the other members of the Saturnian family would be duly formed, and, unless disturbed by some similar action in the planetoid, would all be produced revolving around the parent mass in the plane of its equator. But such disturbance would be impossible, since no such great upheavals could occur as upon the helioid, nor could those that did occur produce relatively equal effects, because the radii of the

Saturnian System being so much shorter, there could not be that approximate equality in the time of revolution that was needed to permit an upheaval to produce its full effect. For, if it continued too long, it would, as I have shown, act in a contrary sense, the *permanency* of the work being dependent upon the temporariness of the upheaval. Hence, although there may have been upheavals upon the planetoid, their results were small, as is shown by the smallness of the inclination of the orbits of the Satellites and Rings, to the planet's equator.

The inclination of the Moon's orbit to the equator of the Earth is the other of these anomalies. It has already been so far discussed as to show that upheavals upon the solidified earth could not have produced it; nor even when nebulous, could they have affected it much.

It may justly be asked, if upheavals upon the great central body were capable of elevating or depressing the planetary orbits, why those upon the planets should not also affect the orbits of their Satellites?

There are two reasons that occur to me why the effects of the planetary upheavals, although the same in kind should be less in degree.

First, the lower temperature of these smaller systems would probably give less energy to the upheaving power, and therefore, the undulations would be less in proportion. The second, and the

more important reason, is that based upon the greater differences between the angular velocities of the Satellites and their primaries. On this account, the element of compensation which was eliminated from the primaries, as has been shown, would here reappear. For, suppose, in case of the Earth, an upheaval occurred, e. g. in lat. 45°, on the line connecting the Moon's and the Earth's centre, and that the Earth at that time extended to the point of equal attraction between the two, and that it revolved as slowly as a Satellite would at that distance, which would be slower than its actual speed, yet, even in that case, the upheaval would gain so rapidly as soon to be placed in a similar position upon the opposite side, and there undo its previous work. Still, the upheaval would at some time disappear, and as that could hardly happen just at the point to counterbalance all its effect, some moderate residuum of change would be left, a condition which finds its counterpart in the present small inclinations of the orbits of nearly all the Satellites.

It remains to consider the effect of an equatorial upheaval occurring on the surface of the helioid, precisely as in the case of Saturn. Was the lunar-telluric mass inclined 23½° and more, and then was the moon brought back to 5° ? If such a thing was done in case of one of Saturn's moons, could it be done in case of our Earth's ? I think not, for there are certain important points of difference.

The primary ring had been gathered into the lunar-telluric spheroid, a secondary ring cast off, and that gathered also into a spheroidal body, a great length of time, therefore, must have elapsed since the avulsion of the first, which would give the helioid time to condense to a considerable degree, and allow a space between its surface and the Moon of, say half the distance allowed for the same process in case of Saturn, or 7,000,000 miles. By Kepler's law, the time of rotation of a body at this surface will be such that by no possibility could it be exposed to the action of such an upheaval for much more than two one-hundredths as long as Saturn, a time so greatly shorter that it seems absurd to compare the results. Moreover, the diameter of the Moon's orbit is so much less than that of the orbit of Saturn's eighth Satellite, that there would be far less inequality in the counteracting movements at M and M′. Hence, I cannot think the present separation of 18½° between the plane of the equator and the orbit of our moon, is due to this cause.

But, even admitting the possibility of the present difference between the inclination of the Moon's orbit and the Earth being caused by such an upheaval, the fact remains, as already shown, that it might have been caused otherwise. It then would be a question of evidence, did this difference occur before our globe had ceased to be a nebulous mass? for when it had become solid,

the Sun had shrunk too far away for upheavals on its surface to produce any effect. The evidence is clearly negative, for the records of life show plainly that, in the earlier Geologic Epochs, the axis must have been nearly perpendicular. The only objection to this, as far as I know, is the enormous circumpolar upheaval needed, but this objection applies with at least equal force to a Solar upheaval, indeed, the latter would need to be the greater, and it is no more easy for me to think of an equatorial protuberance (not belt) on the Sun, of many hundred millions of cubic miles, than of the needed polar movement upon the earth.

Both are inexplicable at present. Upheavals have occurred, and are now occurring, in Sun and planet. It is simply a question as to the degree of a movement, of which we know neither the cause nor the limit.

Hence, we are led to identically the same conclusion as that arrived at in the previous chapter, viz. that the present difference between the inclination of the earth's axis, and that of the Moon's orbit, is not in any material degree due to any movement of that orbit. And that consequently there must have been a movement of the earth itself, changing its axial inclination from about 5° 9′ to 23½°, and that this occurred since the separation of the Moon from the earth, and between that great event and the beginning of historical records.

The precise Epoch has already been considered.

The inclination of the Solar axis is the residuum or resultant of all these movements, or rather of their reactions.

These principles indicate clearly the possibility of a System presenting a far greater variety of movements and inclinations than is found in our own. Some planets might revolve in a direction opposite to that of their Satellites.

Something approaching this is now seen in case of our earth and her moon. The former revolves from due West to due East, while the other moves from W. 18½° S., to E. 18½° N.

The inclinations of the axes of the Satellites can be accounted for upon the same principles. As far as known they are very small, as was to have been expected. This arises not so much from the smallness of their primaries as from the shortness of their orbital radii, causing a greater difference between their times of orbital revolution, and those of their primaries, hence affording less opportunity for upheavals to produce their effect.

While the nearness of the Satellites produces this negative result, it is curious to note that the equality of lunar orbital and axial revolution flows from the same cause.

This equality certainly exists in case of our own Satellite, and observation seems to render it highly probable in case of all the others.

This we shall consider in another chapter.

It remains only to complement this discussion by showing that an upheaval upon the surface of the Sun at as late a period as the appearance of organic life, could produce no sensible effect upon the position of the earth, or any other planet. That this is true, is evident, because the earth and Sun had then shrunk to their present dimensions, and consequently the upheaved mass was so much more distant than at the time immediately following the segregation of the earth; and, secondly, a mass placed even at the pole of the Sun would be separated from the centre by so small an angle as practically to make its effect the same as if placed there. Hence, no upheaval on the surface of the Sun at so late a period, could produce any effect differing materially from that arising from the direct action of that body.

CHAPTER II.

THE ROTATION OF THE MOON.

THE curious coincidence between the time of lunar axial, and orbital revolution, which extends to some, and perhaps all, the other Satellites, is explicable as the result of the nebulous condition of our System, and the nearness of these bodies to their primaries.*

The Moon was once a gaseous mass. It passed by insensible degrees from that condition to a fluid, and then, through ever increasing degrees of viscidity, to a solid.

In its earlier stages of development it revolved on its axis at a rate which was a function of its orbital motion, and of its condensation. As the latter was very great, its effect could not have been null, therefore the axial motion generated by the two could not have produced an angular velocity as small as the orbital; hence, originally, the Moon revolved on its axis with a velocity greater than at present.

There has, then, been some retarding cause,

* The once liquid condition of the Moon was assumed, I think first by Newton.

for no change occurs in matter spontaneously. It must have been in some way intimately associated with the orbital motion, since it reduced the axial to it, and then ceased to operate, or at least to make itself manifest.

The Moon, while in a fluid condition, was affected by tides, surpassing those now on the earth, since the latter's mass is ninety times greater; and the lunar ocean's depth extended to its centre. Partly by the friction of the lunar wave, and infinitely more from its viscidity, an ever-increasing resistance to the Moon's axial motion was generated. At the same time that these forces so much exceeded any present tidal influence on the earth, the smallness of the Moon rendered it less able to continue the contest, her momentum, with the same velocity as the earth, being ninety times less, and ever decreasing as its motion grew smaller.

Moreover, as the time of an axial revolution grew less, the telluric attraction had more ample time to communicate its full effect to the lunar mass, hence the lunar wave attained its maximum height, and its full retarding power.

There was thus generated a force ample to stop the Moon's axial motion in a brief time, as Cosmology counts time.

Evidently, the retardation could proceed no farther than to keep the summit of the tidal wave directly under the earth, as viewed from the

moon, since in that position there was no tendency to move, and hence, no resistance either from friction or viscidity.

A like influence was exerted on the earth by the moon. Owing to the former's greater mass, the effect was relatively small, but it could not have been null.

The Sun, which by that time had shrunk to somewhere near its present dimensions, also tended to produce a retardation of axial motion, but owing to its greater distance, its influence was much less than that of the earth.

The present prolongation of the lunar diameter in the direction of the earth, is the residuum of that ancient tidal wave, or rather it is that wave solidified, a belief that finds confirmation in the general direction of the *ridges* which mark its surface. An inspection of a lunar map shows hundreds of mountainous *ridges*, by far the majority of which run north and south, that is, transversely, or in the resisting line, to such a force as we have been considering. The circular mountain ridges seem to have been an after formation. Omitting these as not to be counted either way, it will be found on a careful examination, that where there is one ridge running east and west, there are one hundred running north and south.

The rough, volcanic appearance of the whole disk is exceedingly suggestive of the last stages of transition from a liquid to a solid condition, the

gradual formation of a somewhat thin crust, the crumpling and solidification of the strata into a tolerably quiescent state, followed by ejections of the internal lava, or the sinking of large tracts as the centre cooled.

At the present time, the tidal wave is retarding the earth's diurnal motion, and it has been said that either the earth is revolving more slowly from year to year, or else that the moon is accelerating its velocity. Both suppositions are true, and both are due to the same cause. The same influence which makes the tide a drag upon the earth's motion, by the law of reaction, necessarily causes the wave to pull the moon forward in its orbit. The one effect cannot exist without the other.

A natural and correct inference is that, in its primal state, while like Jupiter and Saturn, in a yet fluid condition, the earth revolved on its axis more rapidly than now, perhaps as rapidly as those planets. Similar changes are now going on in all the planets with satellites, and consequently their length of day is increasing, and may eventually become equal to that of the earth, a conclusion which renders more certain the impossibility of establishing the diurnal equation of those planets.

Another and curious inference is this, viz. the radii of the lunar orbits are increasing. For, each planet accelerates the orbital movement of its

moons, hence increasing the centrifugal force, and of course pushing them, so to speak, farther away.

In the principles which have been discussed, I think we have reasons why the immense exterior planets rotate more rapidly than the smaller and interior ones. (1) The larger interplanetary distances gave greater "falling room," hence, greater velocity to the gathering atoms, and therefore more motion was generated. (2) Their Solar tidal waves, in the molten masses, owing to their immensely greater distance from the centre of the System, produced less effect, while their lunar tidal waves also, owing to the relatively less masses, and greater distances of their Satellites, had less influence, while (3) their own larger masses gave them greater power of overcoming resistance.

Mars seems to disprove this explanation. Not only was its "falling room" greater than that of the atoms which formed the Earth, thus generating a greater axial velocity, but it had no satellite to retard it, and its solar tidal wave produced but a slight effect. Hence its residual velocity ought to exceed that of the Earth. But, in fact, it is less. Since it revolves on its axis in a period 41′ 19″ longer than one of our days.

The Theory, however, is sufficient for this apparent anomaly. We may, as shown on page 253, conceive of a Cosmic ring aggregated into two

spheroids in one orbit and rotating in the same direction. Unless they were exactly 180° apart, a condition scarcely possible, they would by mutual attraction finally come into collision. This would be attended by a loss of rotatory motion to an extent depending upon their relative masses. If one was immensely larger than the other the resulting loss would be but small; if there was some approach to equality, the loss would be relatively greater.

Thus it is easy to see how a system formed from a nebulous mass, might contain one or more planets whose axial motion, being the resultant of such collisions, might be less than it normally should be.

CONCLUSION.

From a careful consideration of all the facts, I think we may justly conclude, indeed I may say, are forced to conclude, that if a nebulous mass, such as we have supposed, was endowed in its atoms with the power of mutual gravitation, and the unstable equilibrium ensuing disturbed by some exterior force, there would of necessity be generated, in due time, a number of planets of varying sizes, all revolving in one direction about a common centre, in orbits of varying eccentricities and inclinations. That each of these bodies, and the central body, would revolve on its axis, normally, in the same direction. That the axis of each would be more or less inclined at any angle

from 0° to 180°, and that, in case the inclination was more than 90°, the diurnal motion would be retrograde. That if any of these planets, while in the nebulous condition, were sufficiently large, they would also form systems revolving about them, in orbits of greater or less ellipticity, and more or less inclined to the plane of the primary's equator.

Hence, bearing also in mind the evidence of the Spectroscope, it seems impossible to avoid the conclusion that such was once the condition of our own System, and that its present arrangements are the legitimate results of its having once been a nebulous mass, modified and wrought upon by a force of upheaval which has manifested itself from the beginning of the Solar Universe.

This plastic force is Heat, itself the effect of the primal force which drew atom to atom.

Here Science, and even Imagination, must stop, and, unable themselves to go farther, point as guide-boards to an infinite, intelligent Will, the First Cause, the Origin of all force, and of all motion. Of Him it was written, some three thousand years ago, "He maketh his ministers a flame of fire," His servants, His laborers to build up a Universe.

Of that elemental chaos, while yet without form, and void and dark, we read, "The Spirit of God moved upon the face of the waters," the

only term which the limited power of the Hebrew could apply to the mobile mass.

Thus, by a circuitous route, we are back to that living miracle, the Mosaic Account of Creation.

NOTE.—Substantially the same explanation of the curious coincidence between the time of lunar axial and orbital revolution is to be found on pages 416 and 417 of Laplace's Système du Monde, 5th edition.

If any reader cares to look into the matter, I think he will find enough difference to convince him that my article was written without any knowledge of the other. In fact it had been previously stereotyped.

CHAPTER III.

SOME THOUGHTS IN REFERENCE TO THE ASTEROIDS AND SATURN'S RINGS.

THREE theories have long been before the world to account for this curious group. Each assumes that they are fragments of a larger planet, and each differs from the others in the cause assigned for such a catastrophe. One attributes the disruption to centrifugal force, another, to the explosion of confined gases, and yet another, to collision with some foreign body.

The first supposition implies that gravitation can generate a force sufficient, not only to overcome itself, and the cohesion of the mass, but to fling the fragments millions of miles apart.

The second also implies that a centripetal force can generate heat enough to overcome the generating force and the cohesion of the mass, and fling the fragments so far away.

Either is untenable, since no force can generate a force greater than itself.

There remains then, the third supposition, viz. a collision with some foreign body.

This is purely conjectural, a "deus ex machina" to help out of a difficulty. Nor does it aid much,

for if a planet had been struck by some solid body with force enough to scatter the fragments over a zone 240,000,000 miles in width, the blow would have converted both into vapor, and the two, held in the bonds of mutual attraction, would have formed again a nebula. If the blow had been struck in front, so much of the planet's velocity would have been destroyed that, if it escaped falling into the Sun, it would have revolved in an orbit of amazing eccentricity, while in fact the average eccentricity of the group is less than that of Mercury. If struck in the rear, its velocity would have been so accelerated as to send it off into space, in a cometal orbit. In whatever way we suppose the blow struck, the effects are wanting.

Another theory of more recent origin assumes that this group is composed of bodies which came into the solar system from external space, precisely as do meteors at the present day.

To this several objections present themselves which seem fatal.

First, according to the doctrine of chances, it is inconceivable that 150 bodies (or whatever may be the number) should have flown nearly in one plane into our system, and that of all the myriad of possible positions and directions they should have taken that in close harmony with the Nebular Hypothesis. Second, if these bodies, or any one of them, came from somewhere outside their present orbits, they must in that earlier epoch have

been within the sphere of the Sun's dominance, or beyond it. In the former case, they would to-day continue to revolve in an orbit passing through that "somewhere," and hence possessing an eccentricity immensely greater than they now do, unless some other attraction has interfered and reduced the ellipticity to its present dimensions.

This interference could come only from the exterior planets, or from some contemporaneous upheavals in the helioid, such as have been under consideration.

As to the effect of a planet, it is utterly inconceivable that even Jupiter, the largest, could have so equally affected a group 125,000,000 miles wide, containing so large a number of bodies differing all possible degrees in their angular position, that no one of their orbits is much more eccentric than is Mercury's, while most of them are less so. As to the effect of an upheaval, the same objections apply.

If, however, the Asteroids came from the depths of space beyond the dominance of the sun's attractive power, the difficulties of such a theory become, if possible, even greater. For not only would there be needed an impelling force to push them within the power of the Sun, but any such impulse would send them towards our system with a velocity and consequent momentum which would carry them off again into space in a parabolic orbit, never to return.

The facts, then, of the solar system, are such

that this theory cannot be true. What remains? The ordinary laws and movements. These, applied in accordance with the idea that the whole Cosmos was generated from a nebulous mass, will, I think, give a not unreasonable explanation of the peculiarities of this group. First, then, as far as yet known there is no reason in the nature of things why, as the equatorial portions of the central nebula approached that condition of equilibrium in which the centrifugal force was equal to the centripetal, and a belt of matter was about to be segregated, this effect should take place in a belt of 100,000,000 miles wide, rather 10,000,000 or 1,000,000, unless it was determined by the greater or less viscidity (so to speak) of the central mass. For, although the cosmic forces must be considered as in themselves uniform, yet, according to all experience and observation, their manifestations vary in degree, as sometimes the surface of the Sun seems almost perfectly quiet, while at others it is upheaved in a commotion that transcends the flight of imagination. Less viscidity then, aided, perhaps, by the action of the greater planets, may, without any forcing of theory, have caused the avulsion of narrow belts, say 1,000,000 miles in width, each finally gathering itself into a planetary spheroid. This condition may have continued until belt after belt was left behind in a zone of an average width of 125,000,000 miles. There may have been as many rings as asteroids,

but I think it much more probable that two or more were formed from one ring. This would account for the almost equal diameters of the orbits of some of these bodies. The mode in which this might be brought about, has already been pointed out.

Upheavals upon the surface of the central mass, similar to those previously discussed, and which would be unusually frequent in such a time of increased activity as then existed, would produce the variety and extent of orbital inclination and eccentricities which those little planets present. And this the more, since the small mass of an asteroid would cause the upheavals to produce the larger effect. Hence we should expect the extremest orbital eccentricity and inclination found in the System. The extreme obliquity of some of these orbits appears to be a crucial fact, demonstrating the influence of some power not exerted in the plane of the larger planets.

Hence I conclude that this curious group is no anomaly, but that it is a manifestation of the working of principles which developed our system, and the result of forces still active.

AS TO THE PLANET SATURN.

Eight belts have been thrown off, and have formed themselves into Satellites, while others are packed together in a group of rings which yet retain their original form.

In regard to these, an interesting question has arisen as to the Cause of their retaining their form and position.

From reason and analogy it seems that they ought, before this, to have condensed into moons. It has been shown mathematically that they cannot possibly be solid masses. The most generally received opinion appears to be that they are belts of small moons, infinite in number. But if so, they must exert an attraction upon each other that would result in their aggregation into one or more Spheroids. For it is impossible to conceive of such an infinite number of bodies revolving in nearly parallel orbits without condensation and final solidification, unless some counteracting force prevent. This force, I take it, is found in the intense heat of the primary which keeps up the vaporous condition, and will permit no condensation until Saturn itself shall have cooled to a much lower temperature.

The fact that the moons are all exterior to the belts, the nearest being 37,500 miles farther from the surface of the planet than the outer edge of the most distant ring, favors this view, since, by the laws of radiant heat, they (the moons) would be far less influenced by the temperature of the primary body. Moreover, the greater transparency of the inmost (or "dark") ring, and its small power of reflecting light, would be the legitimate consequences of its greater proximity

to the planet whose heat caused it to assume a condition analogous to superheated steam, but was not sufficient to make it incandescent.

We may obtain some idea of the temperature, and consequent condition of the rings, by changing the scale and comparing the planet to melted iron, although its very small specific gravity seems to indicate a much higher degree of heat. Suppose, then, the planet to be a sphere of molten iron 100 feet in diameter. One who has stood near the metal flowing from the vent of a large furnace for some heavy casting, can, perhaps, form an approximate idea of the intolerable heat of such a mass.

Twelve feet from its surface would denote the interval to the inner or dark ring. At this distance iron would soon become white hot, and the softer metals melt and some be vaporized; twenty-five feet denotes the distance to the second ring, and sixty-five feet, to the outside of the exterior ring. Even here wood would be ignited, and many substances vaporized, indicating a temperature incomparably greater than that which forms our clouds.

The arrangement into parallel rings follows necessarily from such a formation, and from the varying velocities of different portions of the rings, as well as from differences of levity and of temperature needed to vaporize their materials.

One cannot compare the densities of the planets

without being impressed by the inequalities, and the apparent absence of any law.

It may be assumed that the density of a planet is in some degree an indication of its temperature. It is not difficult to understand that a large planet would require a much longer time to cool to a solid than a small one, and that quite possibly the rate of cooling was slower than the rate of planet segregation, and that a body like Neptune, some seventeen times more massive than our earth, might, even at this almost infinite distance from the time of its formation, retain a sufficient amount of its primeval heat to render it one-sixth as heavy as our earth, while Uranus, which is only thirteen times more massive, should have attained a density somewhat greater, although it does seem somewhat hard to believe that these should possess *so much more* levity than our young world.

Saturn being ninety times larger in mass, it seems more reasonable that we should find there a still higher remaining temperature, and a still smaller specific gravity.

Jupiter, formed so long after Saturn, and weighing three hundred times as much as our world, is found to have nearly double the specific gravity of the former, a fact which indicates a lower temperature.

Passing to the planets within the orbit of Jupiter, the increase of density is great, but perhaps no more than is due to their smaller mass,

and consequent more rapid loss of heat; nor is the difference of density among them remarkable, being much less than is found among the solid constituents of our earth.

The most marked discrepancy, all things considered, is that existing between the density (or temperature) of Saturn and Jupiter. The former ought, by superior age, and inferior mass, to be cooler, and consequently more dense than the latter. But as this is not the case, there must, from some cause, have been less loss of heat by radiation. Did the smaller loss come from less radiating power? This implies a considerable difference in the constitution of the two planets, greater than seems reasonable, if they once formed portions of the same nebulous mass, existing as it must have done, in a state of violent agitation.

I think we find one true cause of Saturn's greater heat in the peculiar arrangement of its own system. The rings radiate and reflect back upon it much of the radiant heat of the planet. All know the retaining effect of a light cloud in our earth's atmosphere, but here is a belt having a radiating surface (both sides) of about 29,000,000,000 square miles, a surface, as it seems to me, sufficiently large to very materially retard the rate of the planet's cooling, although their form is unfavorable to producing the maximum effect.

It seems that the belts of Saturn are expanding at the rate of twenty-nine or thirty miles a year. This movement has not continued in one direction very long, or else the rings would have been destroyed. Most probably it is only one of those cloud-like movements, sometimes expanding, and at others contracting, which would naturally be expected in such bodies as I have supposed these to be.

The two outer planets, although denser than Saturn, as by their superior age and less size they ought to be, are yet very considerably less dense than Jupiter, a result that appears unaccountable, save for the same cause that seems to have affected Saturn, viz. a system of rings.

From their immense distance, it is probable that these will never be seen, but of their existence I have little doubt.

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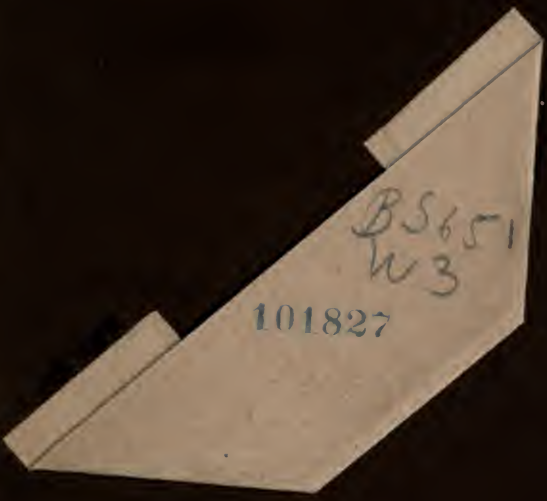
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